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Submission of Certified Copy of Priority Document

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Sir:

Enclosed is a certified copy of the priority document, New Zealand Patent Application No. 523299.

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Respectfully submitted,

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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 20 December 2002 with an application for Letters Patent number 523299 made by SEALED AIR (NZ) LTD

Dated 22 June 2005

Neville Harris
Commissioner of Patents, Trade Marks and Designs

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PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

VACUUM PACKAGING MACHINE AND LOADING SYSTEM

We, SEALED AIR (NZ) LIMITED, a New Zealand company of Corner Avalon Drive and Foreman Road, Hamilton, New Zealand, do hereby declare this invention to be described in the following statement:

#2766

FIELD OF THE INVENTION

The present invention relates to apparatus and a method for efficiently vacuum packaging product packages.

BACKGROUND

Vacuum packaging machines of a known type comprise a vacuum chamber arranged to receive unsealed product packages and operable to perform a vacuum sealing operation on the product packages. Typically the product packages contain products such as meat cuts, arranged in a bag formed by a heat-shrinkable film. After loading and closing the vacuum chamber, the vacuum sealing operation normally comprises vacuumisation, sealing the mouth of the vacuumised bags, and reintroducing air into the chamber. Then the chamber is opened and the vacuum chamber is unloaded. The product packages may then generally be conveyed to a heat-shrinking unit, typically a hot water tunnel, dip tank, hot air tunnel or other shrink activating system.

It is an object of the present invention to provide an improved or at least alternative apparatus for efficiently vacuum packaging products which is suited for use in an automated production line.

SUMMARY OF THE INVENTION

In one aspect the invention comprises apparatus for packing products, including:

a vacuum packaging machine for performing a vacuum sealing operation on product packages,

an upstream product information acquisition stage arranged to acquire information relating to one or more characteristics of the products on a product packing line, and

two or more generally parallel load conveyors arranged to deliver or load products of different sizes into packs and into the vacuum packaging machine, by a lesser number of the conveyors for smaller products and a greater number of the conveyors for larger products.

Preferably the apparatus also includes pack opening means arranged to open the mouth of each pack to a controlled width across the direction of travel of the load conveyor(s), based on information relating to products being packed acquired at the upstream product information acquisition stage and present the pack so that the load conveyor(s) deliver the products into the open packs which are then delivered into the vacuum packaging machine, or deliver the products into the open packs which are already in or partially entered into the vacuum packaging machine.

In another aspect the invention broadly comprises apparatus for packing products including:

a vacuum packaging machine for performing a vacuum sealing operation on product packages,

an upstream product information acquisition stage arranged to acquire information relating to one or more characteristics of products on a product packing line, and

pack opening means arranged to open the mouth of each pack to a controlled extent based on information relating to products being packed acquired at the upstream product information acquisition stage, and to present the pack so that the products are delivered into the open packs which are then delivered into the vacuum packaging machine, or deliver the products into the open packs which are already at least partially entered into the vacuum packaging machine.

Typically the packs will be bags such as plastic bags or sacks. Typically the packs will be sealed at one end and unsealed at the other. The packs may be supplied to the packing

opening means sequentially, as individual products such as meat cuts approach, from a bulk supply such as a stack or rolled stock of packs for example, or alternatively may be made on-line to a standard length, or to the appropriate length tailored to the size of individual meat cuts, by cutting and sealing bags from tube stock for example.

Information from the product information acquisition stage on product characteristics such as size is used to deliver products to the packing stage by activating selected conveyors for the products. For example in a simple form two parallel conveyors may be provided, one of which carries smaller products to the product packing stage and both of which are activated to run in parallel to carry larger products to the packing stage. The two conveyors may have similar or different widths. In another form three or more parallel conveyors may carry products to the packing stage. The conveyors may be "centred" ie a centre conveyor may be flanked on either side by adjacent conveyors of a similar width which may be smaller or larger in width than the centre conveyor, or may be non-centred.

In a preferred form the load conveyor(s) are arranged to deliver products into the packs or bags by also telescoping or moving forward into the packs or bags to an extent dependent upon the size of the product ie further for longer products than for shorter products, again based on product size information previously acquired at the upstream product information acquisition stage.

The pack opening means will typically comprise one or more parts which insert into the mouth of each pack and spread the pack to a controlled extent of opening. Fingers inserted into the pack may open the pack to a variable extent of lift (the height direction, at approximately right angles to the plane of the unopened pack), or to a variable degree of lift combined with a fixed or variable degree of width opening, or vice versa. Where the degree of lift opening is controlled dependent upon the product size, the degree of width opening may be to an extent which is fixed, sufficient to simply take up slack in the bag opening, or which is also controlled dependent on the product size, and vice versa where the degree of width opening is the opening dimension which is primarily

controlled relative to product size. Alternatively means may grip the pack mouth from the exterior for controlled opening of the pack, rather than inserting into the interior of the mouth of the bag.

The acquired information relating to the individual products such as individual meat cuts may include any one of dimensional information such as length information, width information, height information, or any combination of length, width and/or height information, volume or shape information, or weight information, or a combination of one or more of any such information.

The acquired product information may be used to activate both the appropriate conveyor or conveyors dependent on product size as well as the pack opening means to open the mouth of the pack to a controlled width appropriate for the approaching product and position so that the product will be delivered by the conveyor or conveyors aligned to the pack mouth.

In one form the vacuum packaging machine may comprise a plurality of vacuum chambers each arranged to receive at least one unsealed product package and operable to perform an independent vacuum sealing operation on the at least one product package.

In one form each vacuum chamber has a longitudinal direction defined by a direction of loading of packages in to the chamber, and has a heat seal bar therein which extends transversely to the longitudinal direction. Having a transverse heat seal bar in each vacuum chamber enables the product packages to be loaded into each chamber with their openings transverse to the longitudinal direction. This orientation corresponds to the orientation of the packages as they exit most manual bagging stations or automatic packaging systems, which would generally be upstream of the vacuum packaging machine.

The vacuum chambers may be spaced horizontally or, more preferably, may be vertically stacked which provides a smaller footprint. In an alternative embodiment, a 3-dimensional (horizontal/vertical) array of vacuum chambers may be provided.

Preferably, the machine is operable to operate one of the vacuum chambers to perform the vacuum/sealing operation while another of the vacuum chambers is open for loading and unloading.

The heat seal bar in each vacuum chamber is preferably located at the end of the chamber adjacent the load conveyor(s), and the unsealed product package is preferably loaded into the chamber with the unsealed end of the package trailing. In one embodiment the infeed conveyor may telescope over the heat seal bar to load the product into the vacuum chamber with the unsealed portion of the product package being located over the transverse heat seal bar, and then retract out of the chamber so that the chamber may be closed to perform the vacuum sealing operation.

The infeed conveyor(s) may also be moveable generally vertically relative to the vacuum chambers to enable selective loading of more than one chamber. Alternatively, the chambers may be moveable generally vertically relative to the at least one infeed conveyor to enable selective loading of more than one chamber.

Each vacuum chamber preferably includes an internal conveyor for conveying the product package into and out of the vacuum chamber following the vacuum and sealing operation. The internal conveyor(s) may extend under end walls of the vacuum chamber, and for this purpose the undersurface of the belt(s) of the internal conveyor(s) is preferably a smooth plasticised surface so that the vacuum chamber may seal over the conveyor belt.

In an alternative construction, the infeed conveyor for each vacuum chamber may be totally enclosed within the chamber. This configuration has the advantage that it does not require the chamber to seal over the conveyor belting. In this configuration the bottom

portion of the sealing assembly may retract allowing a telescoping conveyor or moving conveyor from the first chamber to operate at the same height as the internal chamber conveyor of the second chamber, eliminating any product "drop" over the sealing assembly. It will be clear to those skilled in the art that other product loading/conveying systems would also be applicable to the machine.

The conveyor arrangement preferably further includes at least one outfeed conveyor operable to convey product packages from the vacuum packaging machine. The at least one outfeed conveyor may be moveable relative to the vacuum chambers to enable selective unloading of more than one chamber. Alternatively, the chambers may be moveable relative to the at least one outfeed conveyor to enable selective unloading of more than one chamber.

An additional feature of the conveyorised infeed, vacuum chamber, and outfeed is that product packages can be loaded and unloaded simultaneously.

In the most preferred embodiment, the vacuum packaging machine includes two vertically-stacked vacuum chambers, a single infeed conveyor and a single outfeed conveyor, the vacuum chambers being synchronously vertically moveable between a loading/unloading position adjacent and between the infeed and outfeed conveyor and an operating position spaced from the infeed and outfeed conveyor, the machine being operable such that as one vacuum chamber is performing the vacuum/sealing operation, the other vacuum chamber is open for loading/unloading.

Preferably one product package is loaded into a selected vacuum chamber at a time for the vacuum sealing operation. Alternatively, the machine may be arranged to concurrently load more than one package into a selected vacuum chamber, the packages being arranged transversely on the infeed conveyor and in the vacuum chamber so that they can be vacuum sealed concurrently.

In a further aspect, the invention comprises a method for packing products, including:

acquiring information relating to one or more characteristics of products on a product packing line, and

delivering or loading products into packs and into a vacuum packaging machine via two or more generally parallel load conveyors, by a lesser number of the conveyors for smaller products and a greater number of the conveyors for larger products.

In broad terms in another aspect the invention comprises a method for packing products including:

acquiring information relating ot one or more characteristics of products on a product packaging line,

machine opening the mouth of each pack to a controlled extent based on information relating to one or more characteristics of the products being packed acquired at an upstream product information acquisition stage, and delivering or loading products into the open packs and then into a vacuum packaging machine or into the open packs which are already at least partially entered into the vacuum packaging machine.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

The invention consists in the foregoing and also envisages constructions of which the following gives examples only.

BRIEF DESCRIPTION OF THE FIGURES

A preferred embodiment of the present invention will now be described with reference to the accompanying figures, in which:

Figures 1 to 8 schematically show operation of a preferred embodiment vacuum packaging machine including product loading system,

Figs 9 to 12 schematically show in plan view the layout and operation of one preferred form of load conveyor foruse in loading products into packs and/or packs into a vacuum packaging machine,

Fig 13 schematically shows in side view the operation of a telescoping infeed conveyor for delivering products into packs,

Fig 14 schematically shows one form of pack opening means,

Figure 15 is an end view of a preferred vacuum packaging machine

Figure 16 is a side elevation view of the vacuum packaging machine of Figure 15;

Figure 17 is a further side elevation view of the vacuum packaging machine of Figure 15;

Figure 18 is a view of the interior of a vacuum chamber, showing a sealing assembly ;

Figure 19 is a perspective view of the upper interior of a vacuum chamber, showing the details of the upper part of the sealing assembly of Figure 18;

Figure 20 is a view of the lower part of a vacuum chamber, showing details of a lower part of the sealing assembly of Figure 18;

Figure 21 is a perspective view of the lower part of the sealing assembly of Figure 18;

Figure 22 shows part of a pulley arrangement for raising and lowering the vacuum chambers in the machine of Figure 15;

Figure 23 is an overhead end view of the machine of Figure 15;

Figure 24 is a side elevation view of the machine of Figure 15, showing a cross-flow valve mechanism for transferring vacuum between vacuum chambers;

Figure 25 is a further detailed view of the cross-flow valve mechanism of Figure 24; and

Figure 26 is a further detailed view of the cross-flow valve mechanism of Figures 23 and 24.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

A preferred embodiment machine comprises a vacuum packaging machine generally indicated at 1 in Figure 1, which is described in more detail subsequently with reference to Figures 15-26, and a pack opening and product loading system generally indicated at 2 in Figure 1, which is described in detail immediately below with reference to Figures 1-8.

Referring to Figures 1-8, in use meat cuts such as that indicated at C are carried by product supply conveyor 3 towards the vacuum packaging machine 1. Meat cuts are delivered by the product supply conveyor 3 onto elevator plate 4 when it is in it's lowered position as shown in Figure 1, and are then elevated as shown in Figures 2 and 3. Movement of the elevator plate 4 is driven by pneumatic (or hydraulic) cylinder 5, which is in turn carried by a moving carriage assembly 6 which moves in the direction of arrow J in Figure 1 on the machine bed 7. For example the moving carriage assembly 6 may be moveably mounted to the machine bed 7 by wheels 8, and driven by pneumatic cylinder

9. When the product supply conveyor 3 has delivered the product onto the elevator plates 4 the forward telescoping end of the conveyor 3 withdraws.

An empty pack such as bag B is picked up from a bulk supply as will be further described, the two sides of the bag mouth are separated, and the bag is brought down from the position shown in Figure 1 to the position shown in Figure 2 by pivoting pack pickup arm 9 which moves in the direction of arrow F in Figure 1. The pack pickup arm 9 in its upper position shown in Figure 1 picks up a fresh pack and then pivots down while at the same time pack presenter arm 10 carrying pack opening means in the form of figures or spoon plates 11 moves upwardly to the position of Figure 2. The partially open mouth of bag B is entered onto the fingers or spoons 11 of bag presenter arm 10 as shown. The bag presenter arm 10 having received a pack then pivots downwardly as shown in Figure 3. As it does so the fingers or spoons 11 are driven apart to open the mouth of the bag further, and preferably to a desired extent to match the size of the approaching meat cut C, as will be further described. Movement of the pack presenter arm 10 and the elevator plate 4 is co-ordinated so that the meat cut is presented to the pack presenter arm 10 as it pivots downwardly as shown in Figure 3, and in doing so enters the open mouth of the bag over the meat cut on the elevator plate as shown in Figure 4.

The carriage assembly 6 is then moved forward (by cylinder 9) to the position shown in Figure 5 to carry the meat cut in the open mouth of the bag on the elevator plate, into the open chamber of vacuum packaging machine 1 as shown. At about the same time product ejector carriage 12 is moved forward as indicated by arrow K in Figure 1. The product ejector carriage 12 is movably mounted in the machine bed 7 and may be driven by hydraulic cylinder 13 for example. The product ejector carriage carries ejector plate 14 which moves in the direction of arrow I in Figure 1 relative to the product ejector carriage 12, and may be driven by a cylinder 15 carried by the product ejector carriage 2. Referring to Figure 6 cylinder 15 is then actuated to move the ejector plate 14 forward to push the meat cut further into the bag, following which the ejector plate 2 withdraws, and product ejector carriage 12 moves back – see Figure 7 - while at about the same time the

fingers or spoons 11 of the bag presenter arm 10 close together and then withdraw so as to leave the open mouth of the bag draped across the lower part of a sealing and cutting assembly within the vacuum chamber, such as a heat sealing anvil as will be further described. The vacuum packaging machine then closes as shown in Figure 8 and carries out a vacuum and sealing operation. At about the same time or prior the product supply conveyor 3 operates to move the next meat cut onto the elevator plate 4 ready to load the next meat cut into a pack and into the next vacuum chamber in the same way.

As referred to above the bag presenter arm 10 includes fingers or plate-like spoons 11 which insert between the separated sides of the mouth of a pack or bag, and then move apart to open the bag mouth, preferably to a controlled degree of height or lift. Optionally similar fingers may be provided on either side which move in a lateral or width-wise direction to open the bag to a fixed or controlled degree of width opening. The degree of lift may be continuously variable dependent upon the size of each individual product or may be stepped between a number of predetermined levels of opening for products within broad size ranges. For each such a size the bag may be opened or spread laterally to a controlled degree which again may be continuously variable dependent on product size, or to fixed steps of lateral opening. The lift opening fingers or spoons and optionally width opening fingers may be controlled by servo motors which adjust the position of the lift and lateral opening of fingers for each bag, by small pneumatic cylinders, or by any other suitable mechanical arrangement. The extent to which the spreader fingers or spoons 11 are driven apart to open the bag to a controlled extent maybe based on information provided from an earlier machine vision or similar stage through which each product passes.

A control system may control operation of the machine as described above, and may also synchronise the arrival of individual meat cuts with the acquired information relating to the individual meat cuts. In another arrangement acquired information relating to each product may be sent directly from a machine vision stage to the packing and vacuuming station and retained in a database at the packing and vacuuming station until that meat cut has arrived, and is then used to open the bag to the appropriate extent for that size of

product. In a yet more sophisticated arrangement individual meat cuts may be tracked along a packing line so that the system can detect if any individual meat cut is removed from the product stream for any reason, to avoid mis-indexing of the meat cuts and packs, and this may be achieved by detecting and tracking the movement of each meat cut from one conveyor to the next. Various arrangements are possible.

Such a product information acquisition stage (not shown) which may be a machine vision system beneath which individual products such as meat cuts pass on a product packing line, may acquire information relating to one or more characteristics of the individual products such as dimensional information. Dimensional information may be simple such as only one of the length or width or another single dimension of each product or meat cut. More preferably the machine vision system is set up to acquire further dimensional information indicative of the size of the meat cuts or the volume or shape of the meat cuts. Weight information may supplement dimensional information acquired by the machine vision stage.

A machine vision stage may comprise a digital camera system which "sees" individual meat cuts and/or a system which directs at least one beam or line from a scanning laser over individual meat cuts with deflection and/or reflection of laser light on the meat cut being seen by a camera system and the resulting information being processed to provide the dimensional and/or volume or shape information in relation to each meat cut. Alternatively the machine vision system may simply be a series of horizontal and vertical beams across the conveyor path at different heights or spacings through which the meat cuts pass, providing information to a control system as to the width and/or height and/or length of the meat cuts based on the number of beams broken by each passing meat cut. Any other machine vision system which enables the acquisition of information as to one or more of product length, width, size, volume, shape or similar may be used.

The acquired information may be supplied direct to individual electronic or programmed controllers for one or more downstream packing and vacuuming stages on the packing line, or to a common control system for a packing line which also controls other stages of

the packing line, and synchronises the arrival of individual products at points along the packing line.

In an alternative form the product information acquisition stage may simply comprise a weighing means such as a weighing conveyor which weighs individual meat cuts and passes weight information for use by a controller of the pack opening means, to open each bag to a controlled extent depending on individual product weight.

Packs or bags may be supplied from a stack or rolled stock or alternatively may be made on-line by cutting and sealing bags from tubes. A range of bag or stock widths may be available in a range of materials such as oxygen barrier materials, export grade packing material, and so forth from which the bags may be selected as directed by the control system. Bags preprinted with different labeling or branding information may also be provided and selected from. Referring again to Figure 1, in a preferred form bags may be supplied from bag magazines 22, each of which contains rolls of prefabricated bags of different sizes and/or types of bags with various properties eg different oxygen barrier or puncture properties or printed labeling information. Alternatively one or more of the bag magazines 22 may be replaced by one or more on line bag making machines (as are known in the art). As each meat cut approaches or is being loaded, the machine control system causes one of the bag magazines to present a bag to bag delivery conveyor 20, of the appropriate size and/or type for the particular meat cut. Bag deliver conveyor 20 passes around rollers 21, and picks up the bag from the selected bag magazine 22 and delivers it closed mouth first to the position of bag B in Figure 1 ready for pick up by the pack pickup arm 9. Where the bags are not printed they may pass below printer 23 and have information printed on the bag, or additional information printed on the bag relating to the specific meat cut to be packaged eg weight or type information where the bags have already been pre-printed with more generic information such as branding information for example. To separate the two sides of the mouth of the bag ready for pick up by the bag pick up arm 9, one or more suction cups above and below the bag mouth may grip either side of the waiting bag and then move slightly apart to separate the two sides of the bag mouth. A series of suction cups or a longitudinally extending

suction bar may be provided above and below the bag mouth. The control system moves the suction cups towards the bag mouth on either side and applies suction at the appropriate time, and releases the suction when the bag has been picked up by the pack pickup arm 9, to allow the pack pickup arm 9 to pivot downwardly to enter the bag mouth onto the fingers or spoons 11 of the bag presenter arm 10. Alternative arrangements for separating the bag mouth may be used however.

Preferred Conveyor Systems for Loading Products into Packs and/or into a Vacuum Packaging Machine

Referring to Figs 9 to 12, products of different sizes such as meat cuts M may be loaded into packs and/or also into a vacuum packaging machine such as for example the preferred embodiment vacuum packaging machine previously described, on parallel spaced conveyors 2.

Any one or more of the three conveyors 2 may be activated by the control system, dependent on the product size. For example when smaller meat cuts are identified by the machine vision system they are directed to a centre conveyor and only the centre conveyor is activated, as shown in Fig 9. The pack opening means may present a smaller pack or a pack which is opened to a lesser extent, into which the smaller meat cut M on the centre conveyor is delivered. The pack opening means may align the packs with the centre conveyor. When the machine vision system identifies a meat cut of intermediate size such as indicated at M in Fig 10, more of the load conveyors 2 are activated to load that meat cut. Referring to Fig 11, when the machine vision stage identifies a yet larger meat cut M, all five of the load conveyors are activated to load the meat cut.

The two or more conveyors need not necessarily be arranged in a "centred" configuration in which smaller meat cuts are delivered to the centre conveyor. For example in an alternative configuration cuts can be aligned to one side with one, two, or more conveyors being activated based on the size of the cut. Fig 10 shows conveyors to one side activated to load an intermediate size meat cut in a non-centred system.

Fig 11 shows one preferred arrangement of a telescoping input conveyor system of the invention that may be used to load meat cuts M into open packs or bags P. The forward end(s) of the one or more parallel load conveyor(s) (dependent on product size) a telescope into the pack which is presented to the meat cut, and then withdraw, depositing the meat cut within the pack within the vacuum packaging machine. Operation of the load conveyors 2 is controlled such that where smaller meat cuts are conveyed by a single one of the input conveyors, the open mouth of the pack is aligned with that input conveyor, which telescopically deposits the meat cut into the open pack. Where the meat cut and pack are larger, two or more of the load conveyors telescope together to deposit the meat cut into the open pack as described above, and the open pack is positioned laterally relative to the direction of forward movement of the load conveyors so that the pack is aligned with the load conveyors loading the meat cut.

In preferred forms the load conveyors of Figures 9 to 12 are arranged to deliver products into the packs or bags by telescoping or moving forward into the packs or bags to an extent dependent upon the size of the product ie further for longer products than for shorter products, again based on product size information previously acquired at the upstream product information acquisition stage.

Alternative Systems for Opening and Loading Products into Packs

Fig 13 shows another arrangement for opening and loading packs with product; which comprises fingers 5 which in operation insert into the mouth of each pack or bag such as those indicated at B, and move apart to open the bag mouth to a controlled degree of height or lift. Similar fingers (not shown in Fig 13) may move in a lateral or width-wise direction to open the bag to a fixed or controlled degree of lateral opening. The degree of lift may be continuously variable dependent upon the size of the individual product or may be stepped between a number of predetermined levels of opening for products within broad size ranges. For each such a size the bag may be opened or spread laterally to a controlled degree of width which again may be continuously variable dependent on

product size, or to fixed steps of width opening. The lift opening fingers and width opening fingers may be controlled by servo motors which adjust the position of the lift and width opening of fingers for each bag, or by small pneumatic cylinders, or by any other suitable mechanical arrangement. The lift and width opening fingers may be mounted for vertical and horizontal movement on peripheral entry frame 6 as shown, or again by any other suitable arrangement.

Typically products such as meat cut C in Fig 13 will approach the packing apparatus on a conveyor such as conveyor 7 for example. In the packing apparatus of Fig 13 the entry frame 6 carrying the spreader fingers is pivotally mounted at 8 so that it can pivot between the upper position shown in hard outline and the lower position shown phantom outline. Prior to or as each product approaches, the spreader fingers enter the mouth of and pick up a fresh bag or pack, and the entry frame 6 pivots upwardly (from the position shown in phantom outline to the position shown in hard outline). The spreader fingers are driven apart to open the bag to a controlled extent, based on information provided from the earlier machine vision or similar stage through which the product has passed. The open pack is thus presented to the product which is conveyed to the open bag, which is then caught by exit conveyor 9 which carries the bagged product onward, pulling the mouth of the bag from the spreader fingers 5. In Fig 2 different degrees of opening of the bag mouth are shown in phantom outline at different positions of the spreader fingers 5.

The apparatus showing in Fig 14 is similar in operation to that shown in Fig 13 except that the bags are brought down into the product flow from above, rather than from below as in the apparatus of Fig 13. In Fig 14 the same reference numbers indicate the same components as in Fig 13. Again entry frame 6 carries lift and width opening fingers in a similar arrangement to the apparatus of Fig 13. The entry frame 6 is mounted so as to pivotally move in the direction of arrow B from position 10 at which the spreader fingers enter the mouth of and pick up a fresh bag or pack, to the lower position as shown. Prior to or during downward movement the spreader fingers 5 are driven apart to open the bag to a controlled extent, based on information provided from the earlier machine vision or similar stage through which the product has passed. Conveyor 7 has a telescoping

forward end 7a which delivers the product through the entry frame 6 and into the open bag as the bag is brought down towards the telescoping conveyor end 7a extending over the exit conveyer 9, so that the product is entered into the bag and the bag is drawn over the product. The conveyor end 7a then withdraws leaving the product in the bag which is then caught by exit conveyor 9 which carries the bagged product onward, pulling the mouth of the bag from the spreader fingers 5, following which the entry frame returns to pick up a fresh bag from bag dispenser point 10.

In the embodiments of Figs 13 and 14 the product items move towards the pack or bag which is stationary or relatively stationary. In an alternative arrangement however the open packs or bag may be moved towards and/or drawn over the stationary or relatively stationary product item. It is also possible that as the product items move, the open bag may be moved to be drawn over the moving product item, so that the pack or bag and product item such as meat cuts are moving towards each other as the product is entered into the bag.

A control system may synchronise the arrival of individual meat cuts with acquired information relating to the individual meat cuts. Alternatively the product information acquisition stage and bagging station may be autonomous, and where bags are opened according to product weight and for example a weighing conveyor may be positioned immediately upstream of the bagging stage. In a preferred arrangement acquired information relating to each product may be sent directly from the machine vision stage to the packing station and retained in a database at the packing station until that meat cut has arrived, and is then used to open the bag to the appropriate extent for that size of product. In a yet more sophisticated arrangement individual meat cuts may be tracked along a packing line so that the system can detect if any individual meat cut is removed from the product stream for any reason, to avoid mis-indexing of the meat cuts and packs, and this may be achieved by detecting and tracking the movement of each meat cut from one conveyor to the next. Various arrangements are possible.

In the embodiments of Figs. 13 and 14 the spreader fingers move height-wise (lift) and width-wise to open the mouth of the pack to a rectangular or square shape. This is not essential and the spreader fingers or equivalent may be positioned to open the mouth of the pack to a non-regular shape more adapted to the shape of the product dynamically, as the product is loaded. A further possibility is that the spreader fingers or equivalent may be dynamically opened and closed as the product enters the bag. For example for a hump back-shaped product such as a typical meat cut,the fingers may open the bag to a controlled degree and then as the product is entered into the bag continue opening the bag as the highest part of the product passes through the bag opening, and then begin to close the bag as the tailing portion or the product enters the bag, and optionally near-fully or partially close the bag. For this purpose the spreader fingers may grip the periphery of the bag or pack mouth. For example a 3D image of the product may be acquired at the machine vision stage and a multiple number of spreader fingers moved to duplicate the shape of the product, and open the bag to the shape of the product, as the product is loaded. Other similar variations are possible.

As indicated previously, packs or bags may be supplied from a stack or rolled stock or alternatively may be made on-line by cutting and sealing bags from tubes. A range of bag or stock widths may be available in a range of materials such as oxygen barrier materials, export grade packing material, and so forth from which the bags may be selected as directed by the control system. Bags preprinted with different labelling or branding information may also be provided and selected from.

Preferred Form Vacuum Packaging Machine

With reference to Figures 15-17, a preferred embodiment vacuum packaging machine is indicated generally by reference numeral 1, which may be the vacuum packaging machine in Figures 1 to 8, is now described in detail. The vacuum packaging machine includes upper and lower vertically stacked vacuum chambers 3a,3b, which are vertically moveably mounted between columns 5. Mounted adjacent the tops of the columns 5 is a

drive mechanism 7 for the vacuum chambers 3a, 3b, the drive mechanism being described in further detail below with reference to Figures 8 and 9.

An electronic control system 8 controls operation of the machine 1, and a keypad/monitor 10 is provided to enable a user to program the control system.

Each vacuum chamber 3a, 3b includes a bed 9 and a chamber hood 11. The beds 9 are synchronously vertically movably mounted between the columns 5, and each chamber hood 11 is vertically moveable relative to the respective bed 9. The chamber hoods 11 are moved via pneumatic rams 12. Alternative drive means could be used such as hydraulic rams or mechanical means including one or more cams driven by a motor or motors to move the chamber hoods..

Each vacuum chamber has a sealing assembly 15 therein, which will be described in more detail below with reference to Figures 4-7. The bed 9 of each vacuum chamber includes a conveyor 13 which operates to position products in the vacuum chamber during loading, and to convey packaged product out of the chamber after it has been vacuum sealed, the direction of travel of the conveyor 13 defining a longitudinal direction of the vacuum chamber.

A conveyor arrangement is provided to load/unload product packages to/from the vacuum chambers. The conveyor arrangement includes an infeed conveyor 17 to load product packages into the vacuum chambers. The operation of the infeed conveyor 17 will be described in further detail below. An outfeed conveyor (not shown) is also provided to remove packaged product from the machine following sealing.

As can be seen from Figures 15-17, the vacuum chambers are moveable together between a lower position (shown in Figures 1 and 2) wherein the upper chamber 3a is adjacent the infeed conveyor 17 for loading/unloading and an upper position (shown in Figure 17) wherein the bed of the lower chamber 3b is adjacent the infeed conveyor 17 for loading/unloading. While one of the vacuum chambers is in the loading/unloading

position, the other chamber is in an operating position to perform a vacuum sealing operation on the package(s) contained therein. Therefore, the operating position for the upper vacuum chamber 3a is above the level of the infeed conveyor, while the operating position for the lower vacuum chamber 3b is below the level of the infeed conveyor.

Having one of the vacuum chambers open for loading/unloading while the other of the vacuum chambers is performing the vacuum sealing operation results in a reduced cycle time over that provided by a conventional vacuum packaging machine.

As can be seen from Figures 18-21, the sealing assembly 15 in each vacuum chamber includes an upper part 15a and a lower part 15b. The sealing assembly 15 extends transversely to the longitudinal direction of the vacuum chamber, and therefore to the direction of travel of product packages through the chamber. This enables the product package to be delivered to the vacuum chamber with its unsealed portion trailing, which is the orientation in which the product package would exit from prior bagging/wrapping stations.

The upper part 15a of the sealing assembly includes a pair of upper spreaders 19a, a heat sealing anvil 21, a puncturing device having a plurality of piercing knives (not shown), and a clamping deivce 23 having a series of clamping pins 25. The lower part 15b of the sealing assembly includes a pair of lower spreaders 19b which are complementary to the pair of upper spreaders 19a, a heat sealing bar 27, and a lower clamp bar 29.

In this particular embodiment, the spreading operation is as follows. The spreaders 19a, 19b are operable to grip and spread the unsealed part of the product package prior to heat sealing. As will be apparent from the Figures, as the upper 19a and lower 19b spreaders are brought together, they move outwardly by virtue of the angled slots 20a and pins 20b extending therethrough. The spreaders function in a similar way to those described in PCT Publication No. WO 02/10019, the disclosure of that publication being incorporated herein by reference, and will not be described further here.

Alternative spreading systems are also envisaged. In one alternative, an air "curtain" provided by a series of small air jets will be provided to blow the unsealed package neck flat over the seal bar.

A further embodiment would be to restrict the air flow out of the product package during the vacuuming process and to use the resulting back pressure created to spread the neck of the package over the heat seal bar. This restriction may take the form of a bar spaced a fixed distance above the heat seal bar or alternatively a lightly spring-loaded or gravity bar.

These embodiments are examples only, and other automatic spreading systems are envisaged.

The clamping pins 25 and lower clamp bar 29 (which would generally be made from a resilient material such as rubber) maintain the unsealed portion of the package in the spread configuration, and provide tension on the product package such that it can be pierced. When the puncturing device is actuated, the knives (not shown) pierce the package. The puncturing device forms small apertures in the product package. During loading of the product package into the vacuum chamber, it is feasible that the trailing unsealed portion of the package may be located such that it will be clamped under the end wall of the vacuum chamber hood 11 when it is closed. The apertures formed by the puncturing device ensure that any air in the product package may still be evacuated if this should occur.

The heat seal anvil 21 is operable to push against the heat seal bar 27 with the unsealed portion of the product package therebetween, applying a current to the heat seal bar and sealing the product package.

Although not shown in the Figures, a cutting device will be provided to cut the product package between the heat seal bar 27 and the puncturing device. The preferred cutting

device is a serrated knife, which is arranged to move downwards from above to shear the product package.

Although not shown in the Figures, the machine includes a scrap removal device to remove the cut-off portions of the product package from the machine. The preferred scrap removal device comprises a "push-pull" system. A series of air jets are provided on the top front face of the heat seal bar. After the unused product package neck has been cut and the chamber opens, the cut portion of the neck will be supported on the clamping bar 29. When the chamber opens this clamping bar will drop down to its home position while the air jets are simultaneously activated. This action will blow the severed bag neck toward a suction system which is mounted below the nose roller of the telescoping infeed conveyor 17. Advantageously, a second set of air jets may also be provided along the bottom of the heat seal bar, just above the internal conveyor 13, to create a full air curtain blowing toward the suction system. A significant advantage of this product loading/chamber system is the relatively small distance between the air jet and the suction system (approximately 100mm). In a conventional rotary system the scrap has to be blown transversely across a gap of approximately 600mm. Other means of removing scrap could be provided.

The belt of the conveyor 13 extends under the lower part of the sealing assembly 15b, and around the outer ends of the bed 9 of the vacuum chamber. For this purpose, the undersurface of the conveyor belt comprises a smooth surface (relative to a conventional cloth surface), for example a smooth plasticised surface, such that the vacuum chamber can seal over the belt.

In order to deliver the product package over the lower part 15b of the sealing assembly, the infeed conveyor has a telescoping portion 17a. During loading of an open vacuum chamber, the telescoping portion 17a extends over the lower part 15b of the sealing assembly, and is operated to drop the body of the product package onto the conveyor 13 on the bed 9 of the vacuum chamber. The trailing unsealed portion of the packaged product will remain located on the telescoping portion 17a of the infeed conveyor. As the

telescoping portion 17a is retracted away from the vacuum chamber so that the vacuum chamber can be moved and closed, the trailing unsealed portion of the product package will drop onto the lower part 15b of the sealing assembly, so that the unsealed portion can be spread and sealed. The sealing assembly 15 is relatively low profile to minimise the product drop distance as the telescoping portion 17a of the conveyor is extended into the vacuum chamber.

In this embodiment, the vertical position of the vacuum chambers is adjusted by means of a drive mechanism 7 comprising a cable and pulley system as shown in Figures 22 and 23. The vacuum chambers are suspended by four cables 31 which extend downwardly to the vacuum chamber beds 9 adjacent each column 5 of the machine, not all of the cables being visible in the Figures. A triple arrangement of pulleys 33 is provided adjacent each corner of the machine. A main drive bed 35 is drivable in a horizontal plane as indicated by Arrow A in Figure 9, and at each corner one pulley 33a is rotatably attached to the main drive bed 35, while the other two pulleys 33b, 33c are rotatably attached to a stationary framework 37. One end of each cable 31 is operably attached to the vacuum chamber beds 9, while the other end of each cable is attached to the framework 37 as indicated by reference numeral 39.

By virtue of the above configuration of pulleys and cables, horizontal movement of the drive bed 35 results in synchronized raising or lowering of the vacuum chamber beds 9. The pulley configuration is such that horizontal movement of the drive bed 35 results in a vertical movement of the vacuum chambers of double the magnitude. For example, a top stroke of the drive bed 35 of 400mm results in a vertical movement of the vacuum chambers of 800mm. However, this 2:1 ratio of vacuum chamber movement versus drive bed movement requires twice the power that would be required for a 1:1 ratio.

To compensate for this, 2 constant pressure cylinders 41a, 41b are provided to counterbalance the weight of the vacuum chambers. The constant pressure cylinders may be hydraulic cylinders, but in this preferred embodiment are pneumatic cylinders. These cylinders 41a, 41b are isolated with their own pressure vessels, which in this embodiment

are the vertical columns 5 of the machine. The cylinders 41a, 41b hold the vacuum chambers in equilibrium, meaning that a lesser amount of force is required to vertically move the vacuum chambers than would otherwise be required.

A further cylinder 43 drives the bed 35 movement and thereby the vertical movement of the vacuum chambers 3a, 3b. By virtue of the constant pressure cylinders 41a, 41b counterbalancing the weight of the vacuum cylinders, only 14% of the compressed air which would otherwise be required to vertically move the vacuum chambers is needed, resulting in energy savings. More importantly, as the two cylinders 41a, 41b which counterbalance the weight of the pressure vessels are isolated with their own pressure vessels 5, in the event of mechanical failure or sudden loss of air supply, the vacuum chambers 3a, 3b will not crash down, resulting in improved safety.

The vacuum packaging machine may optionally include a cross-flow valve mechanism as indicated generally by reference numeral 45 in Figures 24-26. The purpose of the cross-flow valve mechanism is to transfer pressure from a recently-loaded vacuum chamber to a recently-evacuated vacuum chamber.

As mentioned above, the chamber hoods 11 are moved via pneumatic rams 12. Once the vacuum sealing has occurred in a vacuum chamber, and ½ atmosphere pressure has been transferred to the evacuated chamber, an opening force is applied by the rams 12. Once the vacuum is removed from the chamber, the vacuum hood opens under force.

Method of Operation of Preferred Form Vacuum Packaging Machine

The vacuum packaging machine 1 is typically located downstream from an input conveyor system and/or system for loading products into packs as previously described, which may deliver unsealed product packages to the infeed conveyor 17 shown in many of Figures 15 to 26, or directly into the open vacuum chamber(s) as in the system of Figures 1 to 8, the packages being oriented such that the unsealed portion of each package is trailing.

For the purpose of explanation, presume that the lower vacuum chamber 3b is in the lower operative position and is presently vacuum sealing a product package therein, and the upper vacuum chamber 3a is open and adjacent the infeed conveyor 17, ready for loading.

The infeed conveyor 17 is actuated such that the telescoping portion 17a extends over the sealing assembly 15 and is operated to place a product package onto the moving conveyor 13 on the bed of the vacuum chamber 3a. As the telescoping portion 17a of the infeed conveyor 17 is retracted from within the vacuum chamber, the trailing unsealed portion of the product package falls onto the sealing assembly. The telescoping conveyor is equipped with a sensing means to detect the trailing edge of the product and place it just in front of the sealing assembly 15. In a preferred embodiment, the detecting means is a capacitive sensor mounted in the bed of the telescoping conveyor 17.

The hood 11 of the upper vacuum chamber 3a can then be closed and ½ atmosphere pressure is transferred to the recently evacuated lower vacuum chamber as described above with reference to Figures 24-26. The chambers will move to their upper positions, and the remaining air will be evacuated from the lower chamber 3b, the chamber then being opened and the packaged product unloaded while the new product package is simultaneously loaded.

In the upper vacuum chamber 3a, the unsealed portion of the product package is spread by the spreading system. The puncturing device is then actuated, such that knives pierce the unsealed portion of the product package while the clamping pins 25 hold it in the spread configuration against the clamp stop 29. The spreader bars 19 are then released, and the vacuum chamber 3a is evacuated, through the cross-over and vacuum techniques previously described, thereby evacuating any air from the product package through its unsealed portion and/or the pierced apertures.

The heat seal anvil 21 then pushes against the heat seal bar 27, heat sealing the package therebetween. The cutting device then shears the scrap portion of the product package between the heat seal bar 27 and the puncturing device. The anvil 21 is then moved away from the heat seal bar 27. When the chamber moves to the loading/unloading position and opens, the packaged product and the scrap cut-off portion of the package will be released. The air curtain and suction are then actuated to remove the scrap from the vacuum chamber.

In the meantime, the lower vacuum chamber 3b will have already been loaded with a further unsealed product package, and ½ atmosphere pressure is again transferred between the vacuum chambers as described above. The cycle repeats, with the vacuum chambers moving to their lower positions such that the lower chamber is in the operative position and the upper chamber is in the loading/unloading position.

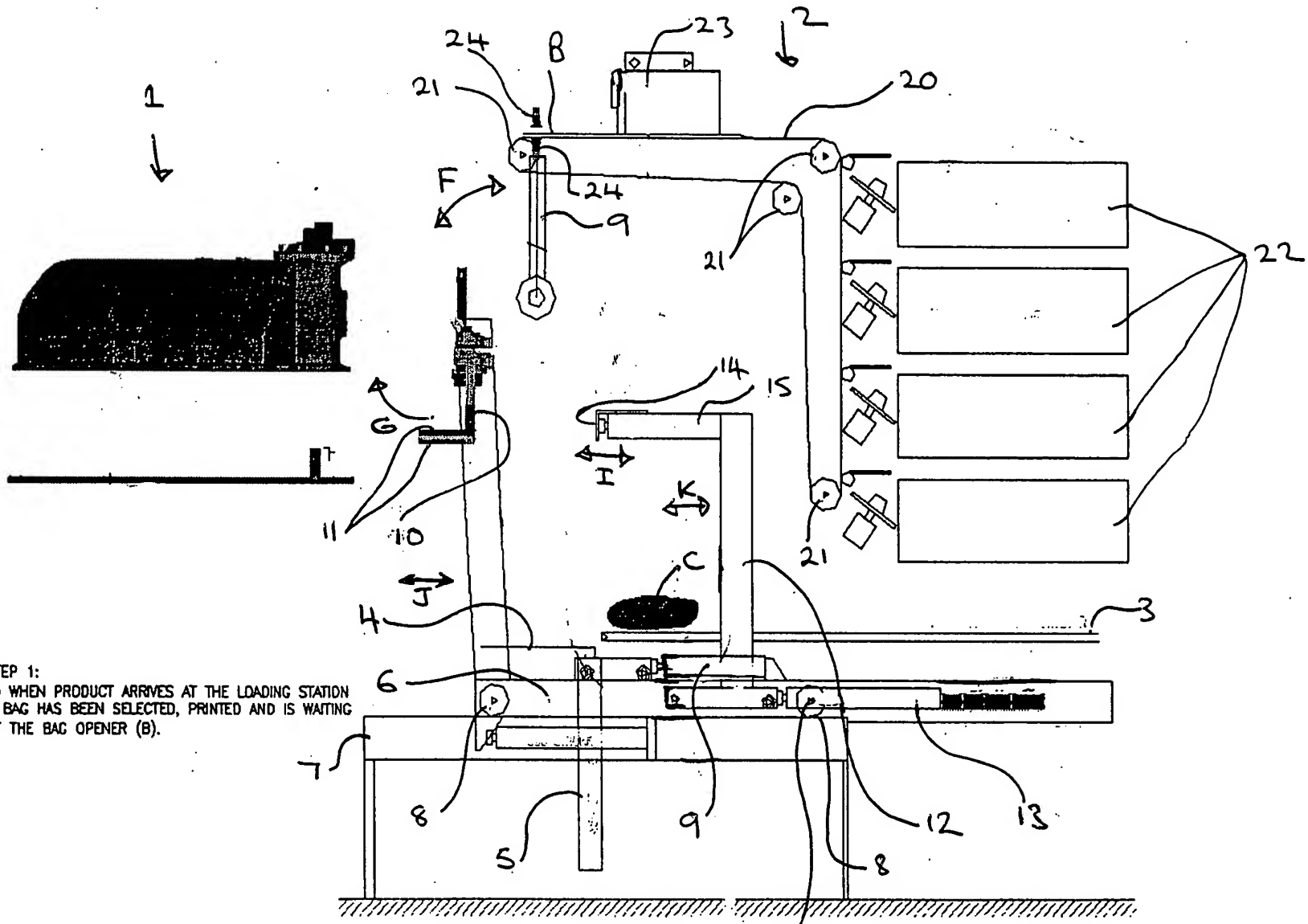
While specific embodiments of the invention have been described above, modifications may be made thereto without departing from the scope of the invention:

While the vacuum packaging machine shown in the Figures includes two vertically-spaced vacuum chambers, it will be appreciated that 3 or more vacuum chambers may be provided.. In addition or alternatively, the vacuum chambers could be horizontally spaced, or a three dimensional (vertical/horizontal) array of vacuum chambers may be provided

While the embodiments of the machine described above have the vacuum chambers being vertically moveable, alternatively the infeed conveyor 17 and outfeed conveyor (not shown) could be vertically moveable and the vacuum chambers fixed. Further, more than one of each of the infeed and outfeed conveyors may be provided to provide a system having higher capacity.

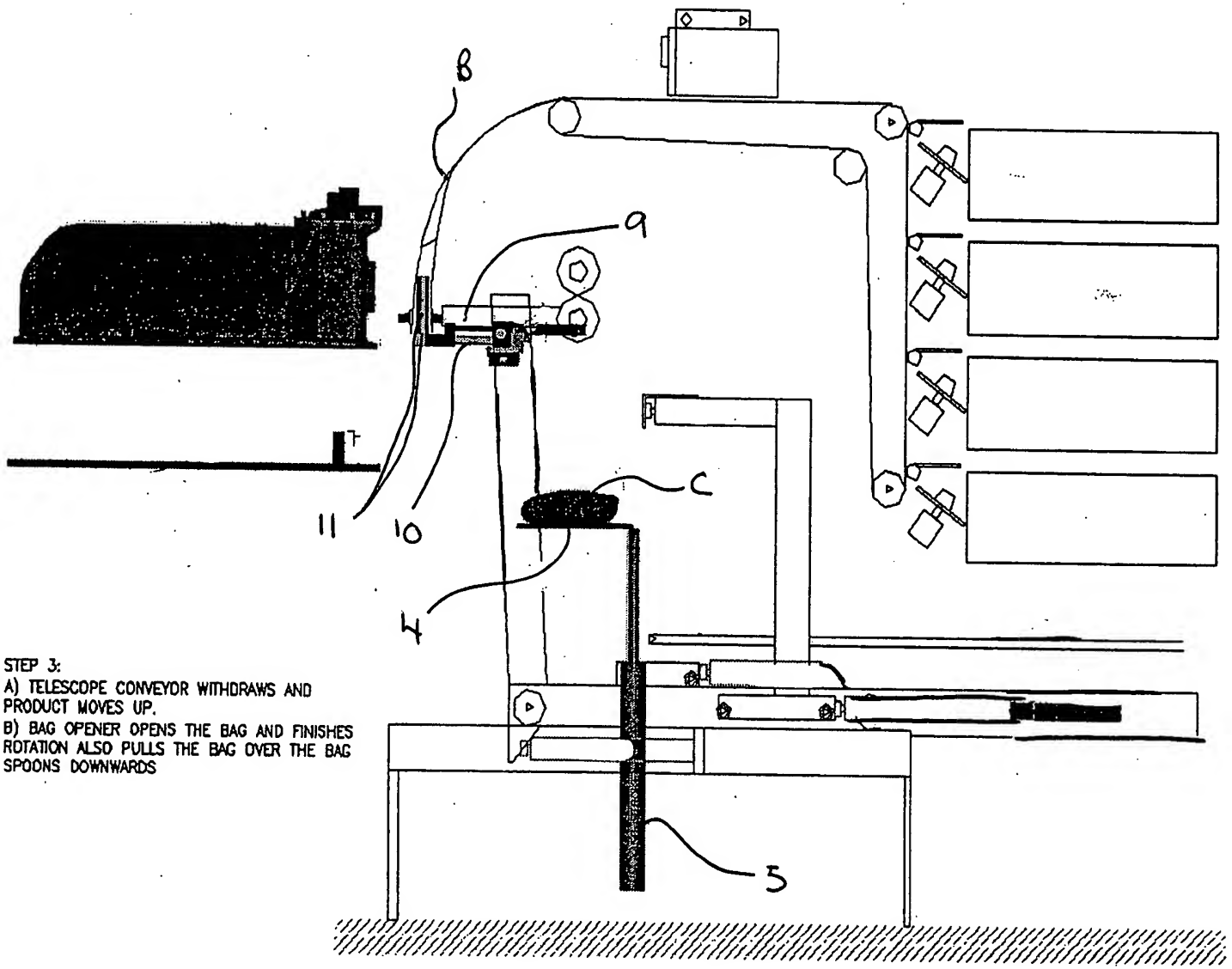
The preferred embodiments described above load and seal one product package at a time. However, it will be appreciated that the infeed conveyor and vacuum chambers could be configured to load and vacuum seal two or more packages situated side-by-side.

The foregoing describes the invention including the preferred forms thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated in the scope hereof.



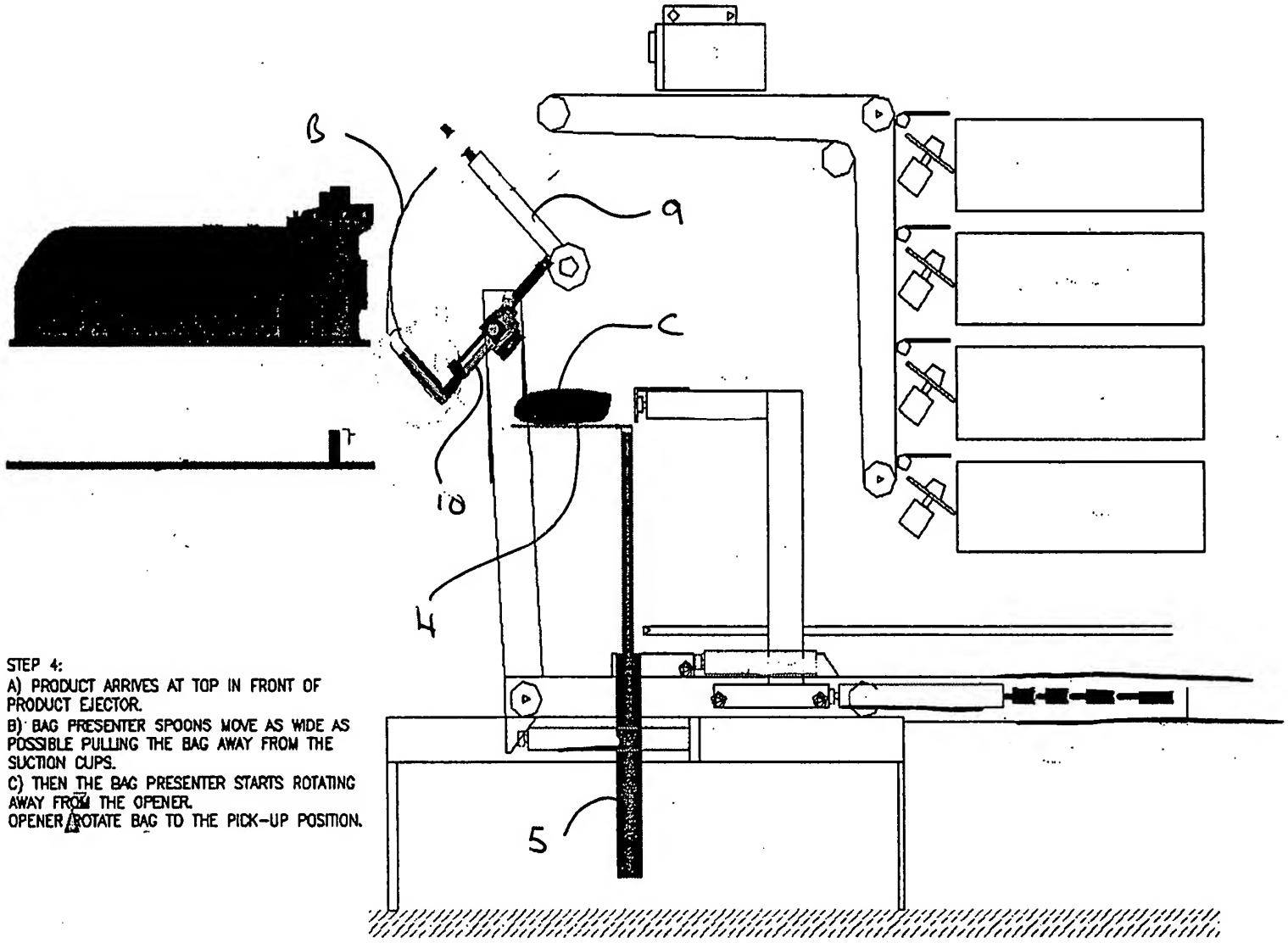
STEP 1:
A) WHEN PRODUCT ARRIVES AT THE LOADING STATION A BAG HAS BEEN SELECTED, PRINTED AND IS WAITING AT THE BAG OPENER (B).

FIGURE 1



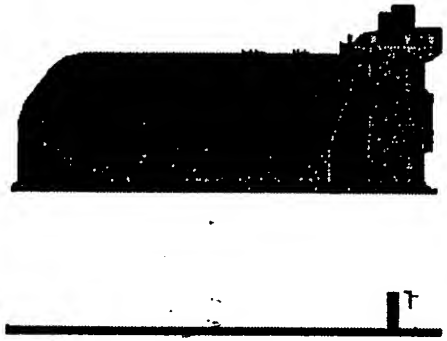
STEP 3:
A) TELESCOPE CONVEYOR WITHDRAWS AND PRODUCT MOVES UP.
B) BAG OPENER OPENS THE BAG AND FINISHES ROTATION ALSO PULLS THE BAG OVER THE BAG SPOONS DOWNWARDS

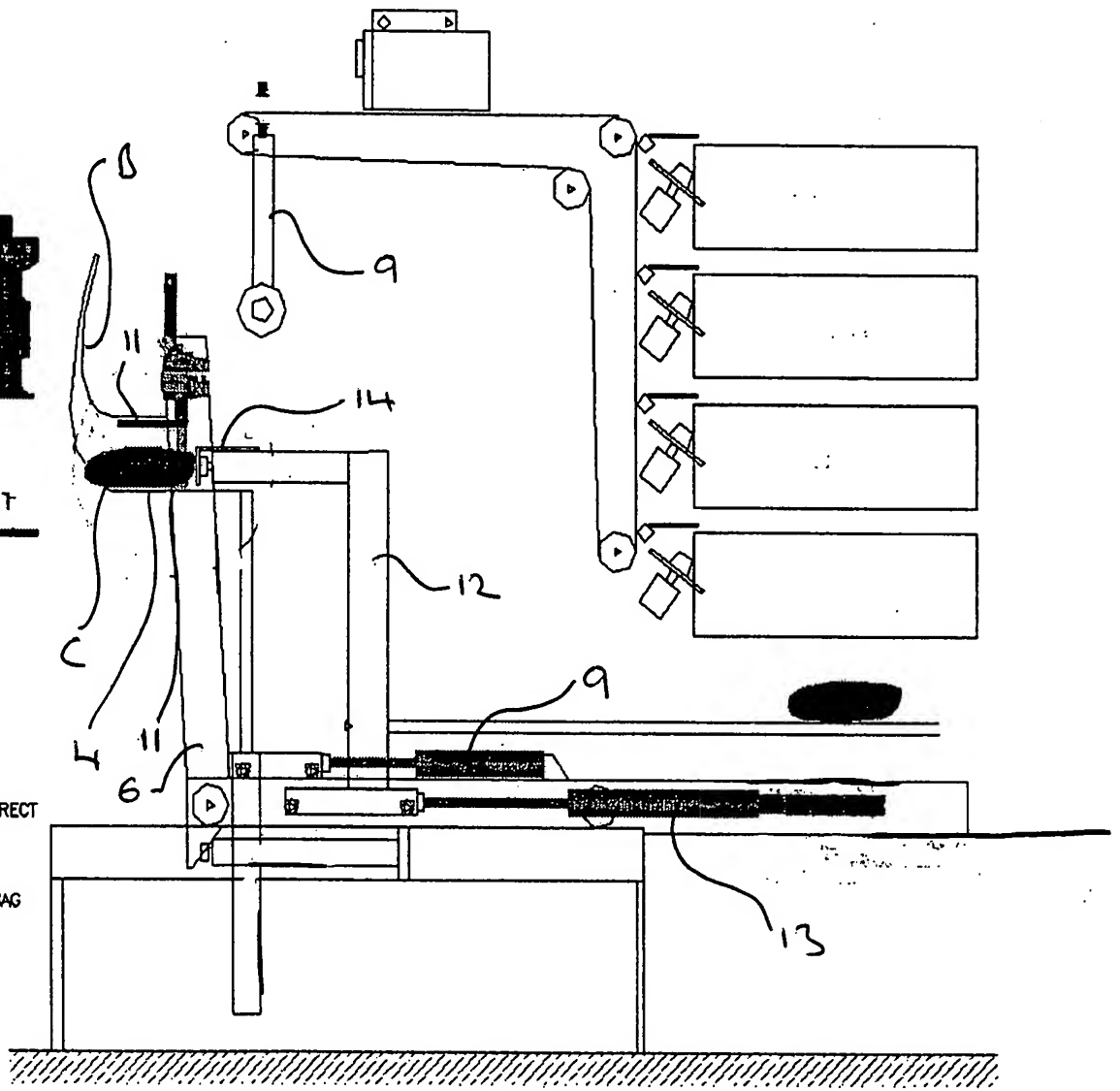
FIGURE 2



STEP 4:
A) PRODUCT ARRIVES AT TOP IN FRONT OF PRODUCT EJECTOR.
B) BAG PRESENTER SPOONS MOVE AS WIDE AS POSSIBLE PULLING THE BAG AWAY FROM THE SUCTION CUPS.
C) THEN THE BAG PRESENTER STARTS ROTATING AWAY FROM THE OPENER.
OPENER ROTATE BAG TO THE PICK-UP POSITION.

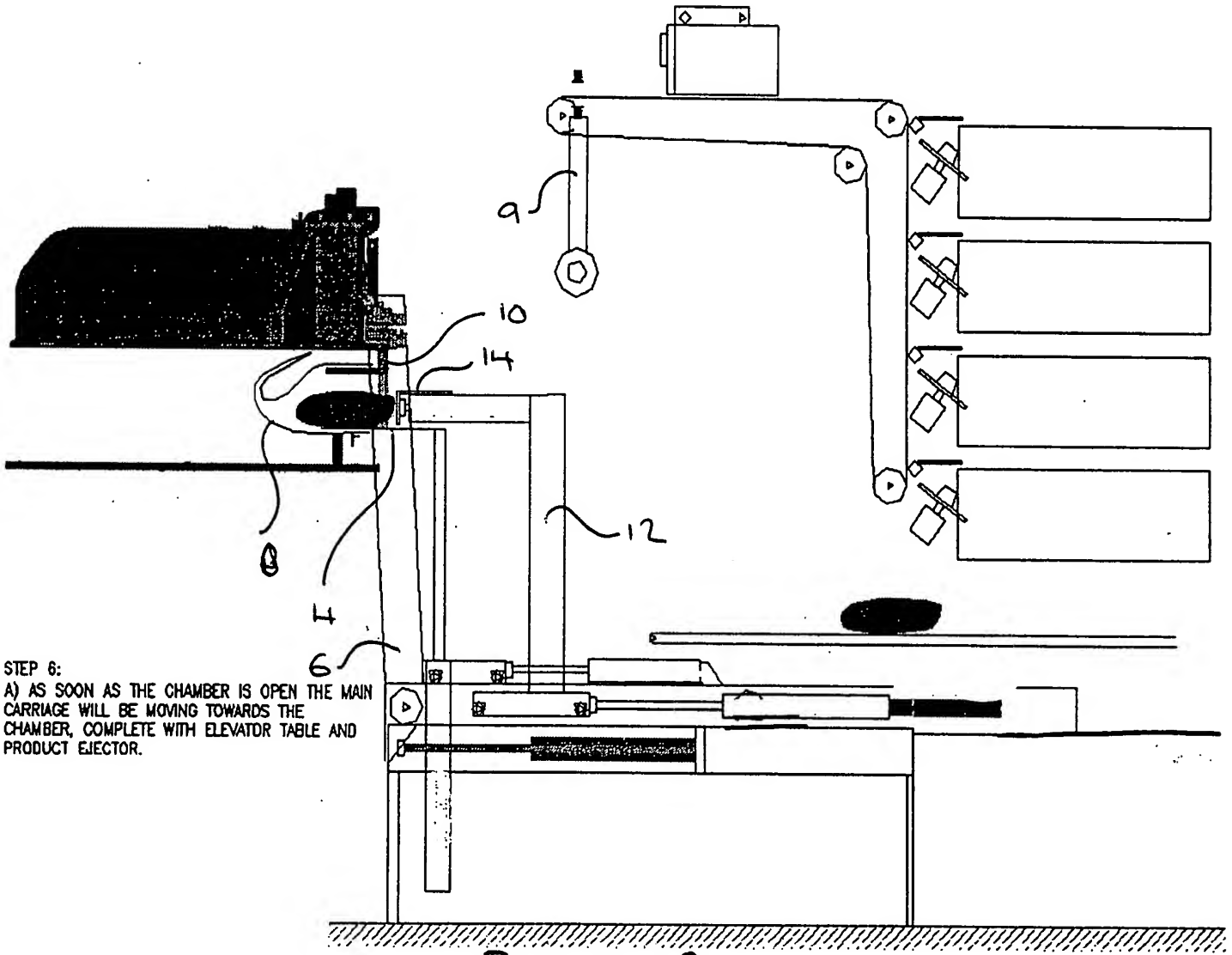
FIGURE 3





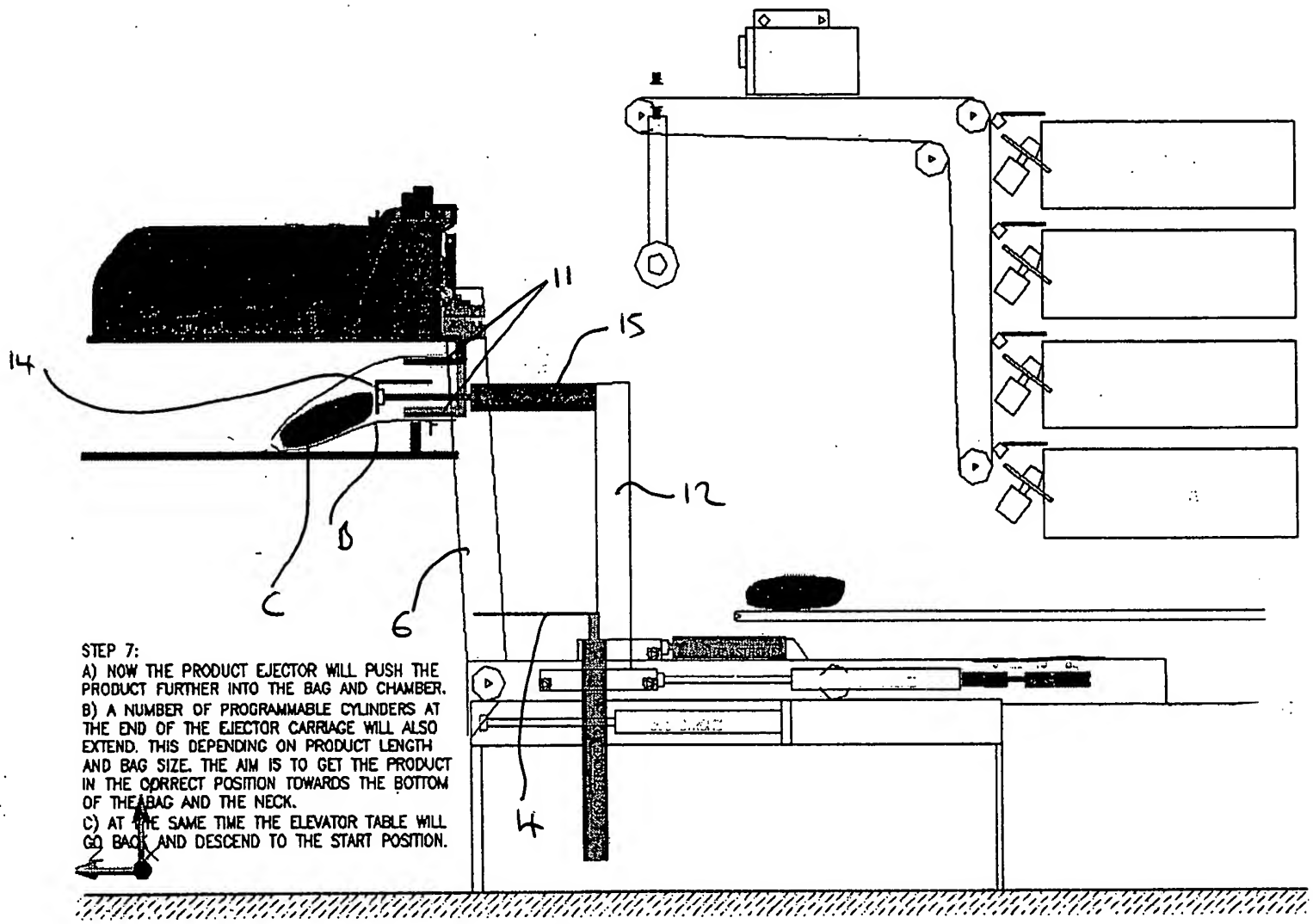
STEP 5:
A) BAG PRESENTER FINISHES ROTATION AND SIMULTANIDUSLY OPENS THE BAG TO THE CORRECT WIDTH.
B) THE ELEVATOR AND PRODUCT EJECTOR CARRIAGES MOVE FORWARD TOWARDS THE CHAMBER, PUSHING THE PRODUCT INTO THE BAG BUT NOTYYET OF THE ELEVATOR PLATE

FIGURE 4



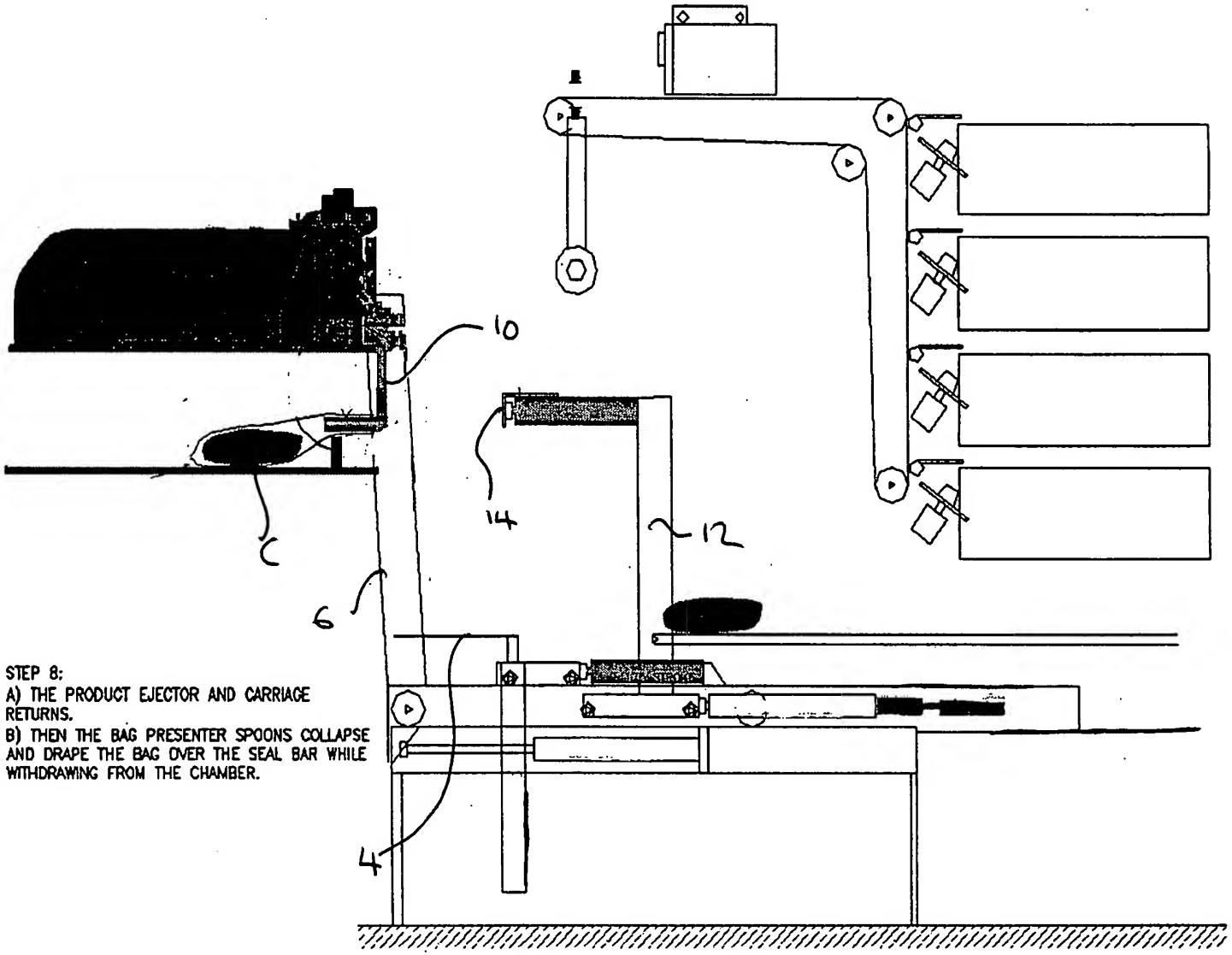
STEP 6:
A) AS SOON AS THE CHAMBER IS OPEN THE MAIN CARRIAGE WILL BE MOVING TOWARDS THE CHAMBER, COMPLETE WITH ELEVATOR TABLE AND PRODUCT EJECTOR.

FIGURE 5



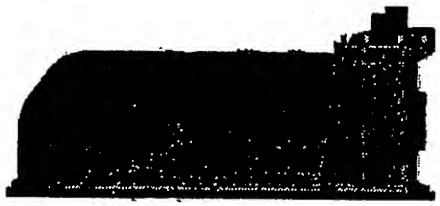
STEP 7:
A) NOW THE PRODUCT EJECTOR WILL PUSH THE PRODUCT FURTHER INTO THE BAG AND CHAMBER.
B) A NUMBER OF PROGRAMMABLE CYLINDERS AT THE END OF THE EJECTOR CARRIAGE WILL ALSO EXTEND. THIS DEPENDING ON PRODUCT LENGTH AND BAG SIZE. THE AIM IS TO GET THE PRODUCT IN THE CORRECT POSITION TOWARDS THE BOTTOM OF THE BAG AND THE NECK.
C) AT THE SAME TIME THE ELEVATOR TABLE WILL GO BACK AND DESCEND TO THE START POSITION.

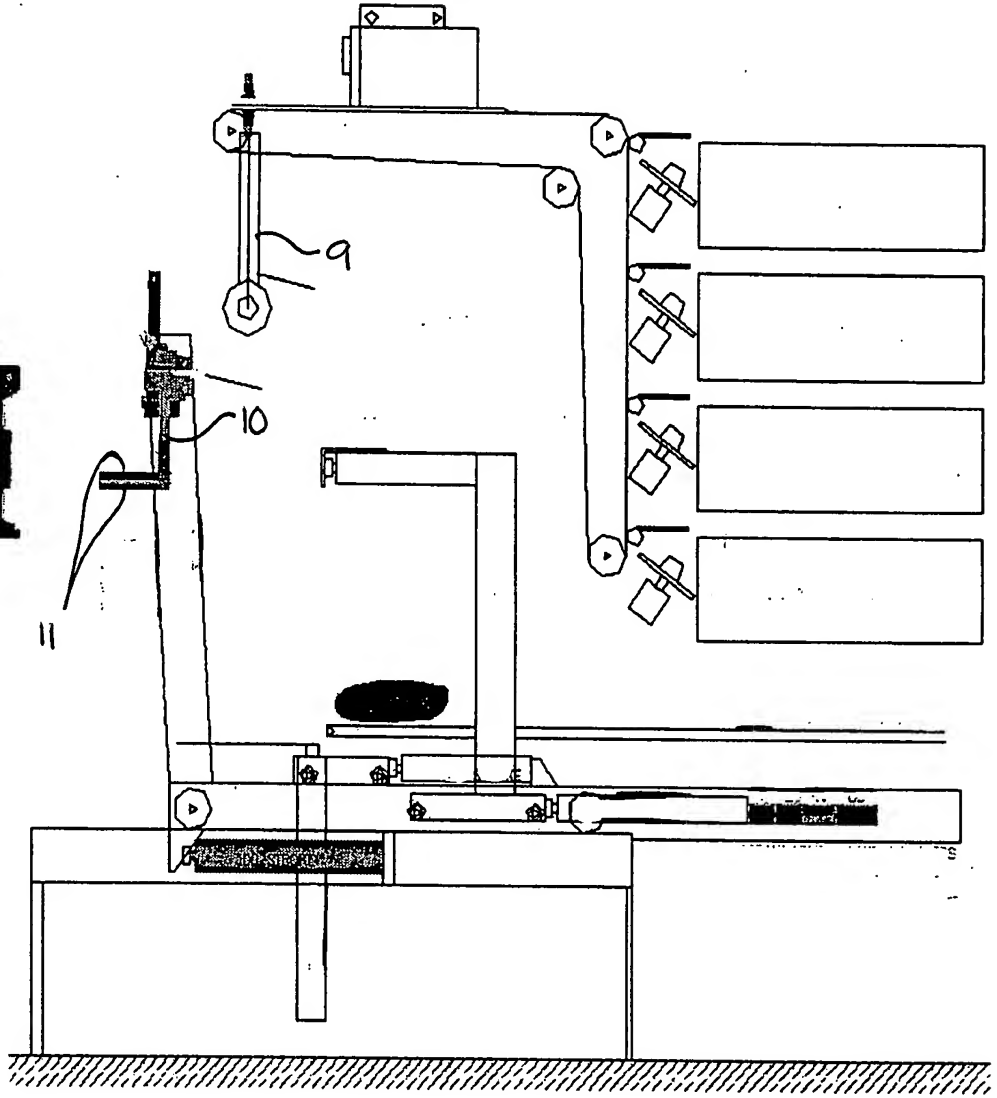
FIGURE 6



STEP 8:
A) THE PRODUCT EJECTOR AND CARRIAGE RETURNS.
B) THEN THE BAG PRESENTER SPOONS COLLAPSE AND DRAPE THE BAG OVER THE SEAL BAR WHILE WITHDRAWING FROM THE CHAMBER.

FIGURE 7





STEP 9:
A)MAIN CARRIAGE WITH BAG PRESENTER WITHDRAWS FROM THE CHAMBER.
B).CHAMBER CLOSES AND MOVES AWAY
GOTO STEP 1

FIGURE 8

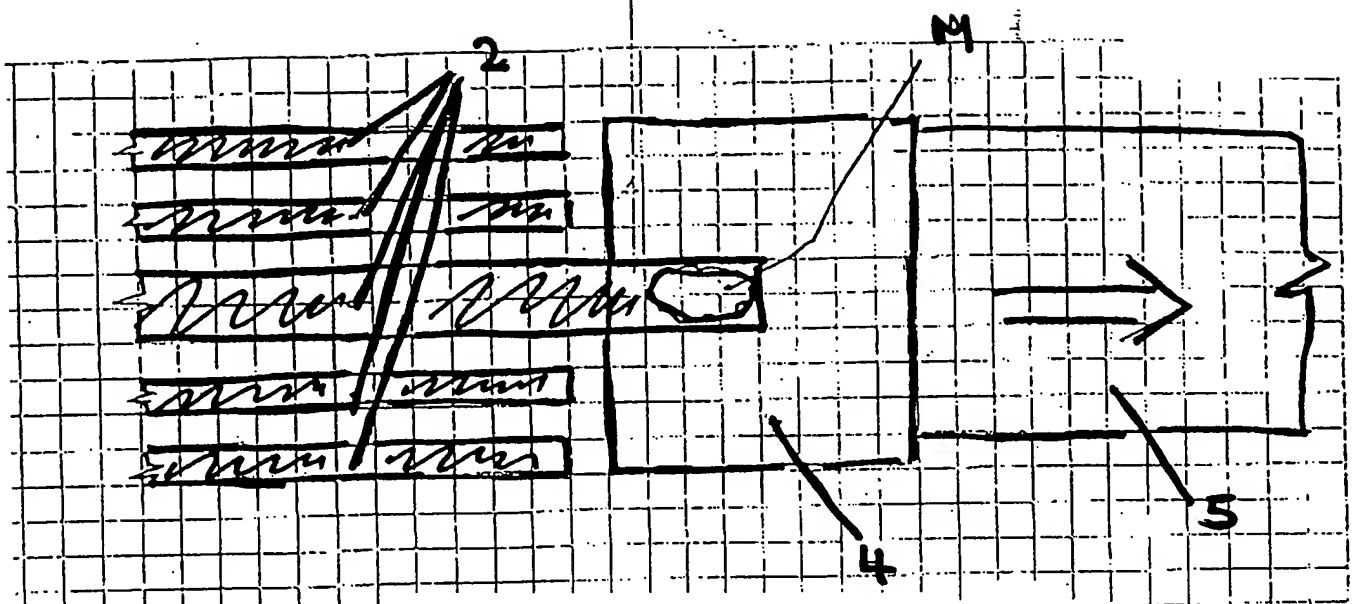


FIGURE 9

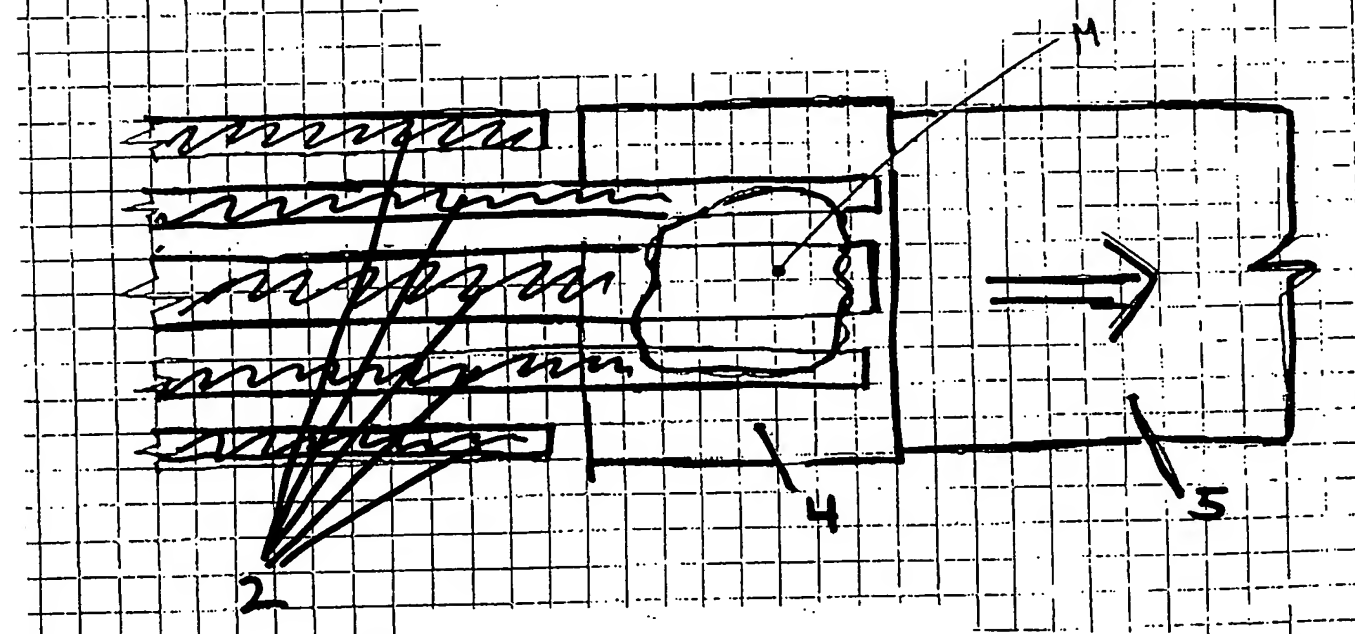


FIGURE 10

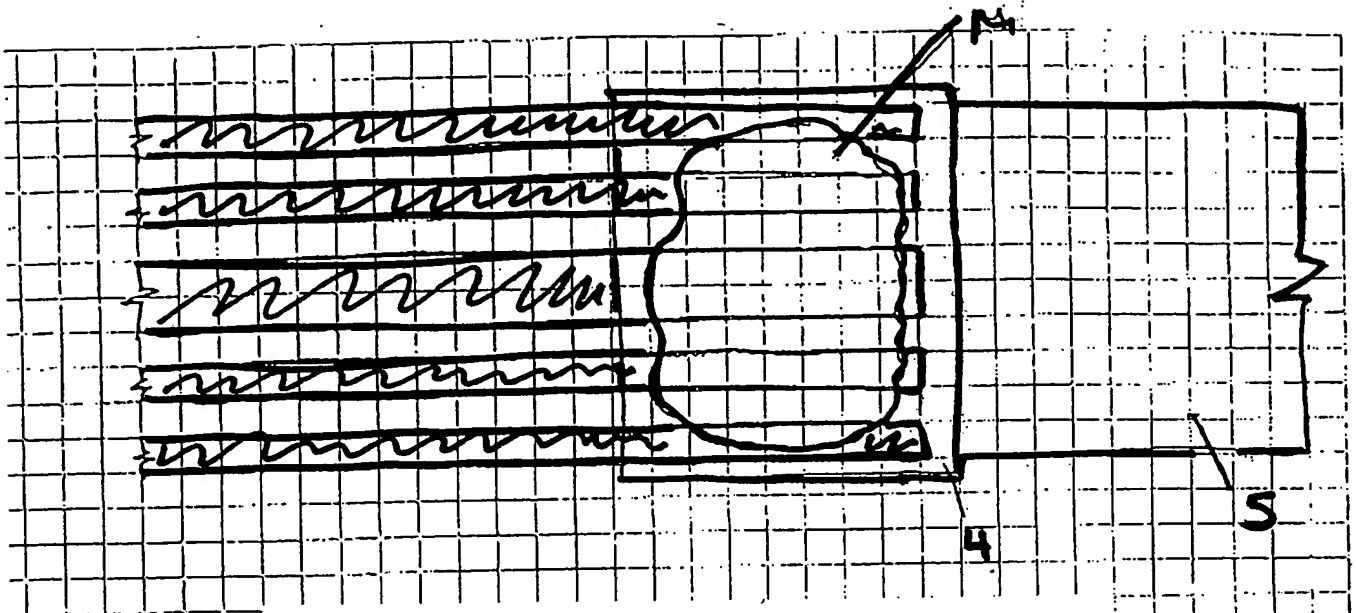


FIGURE 11

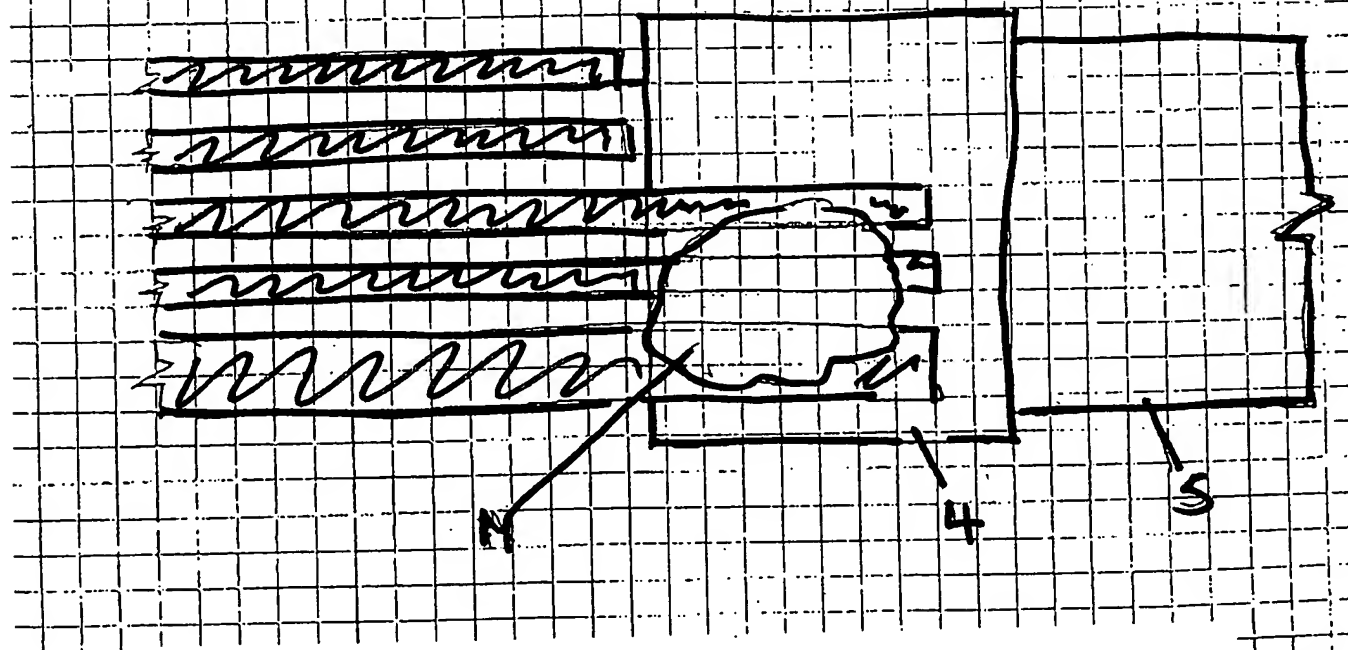


FIGURE 12

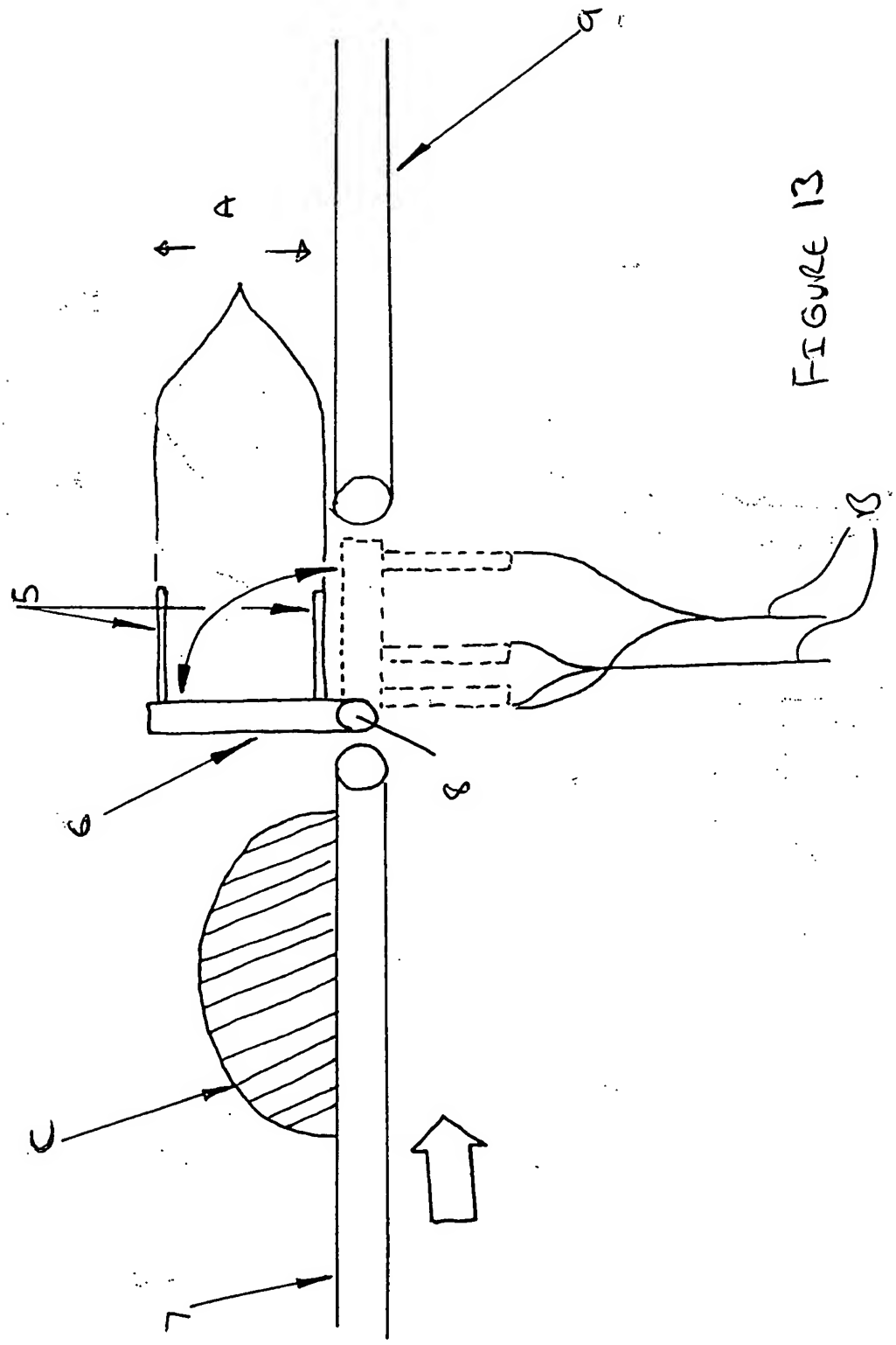


FIGURE 13

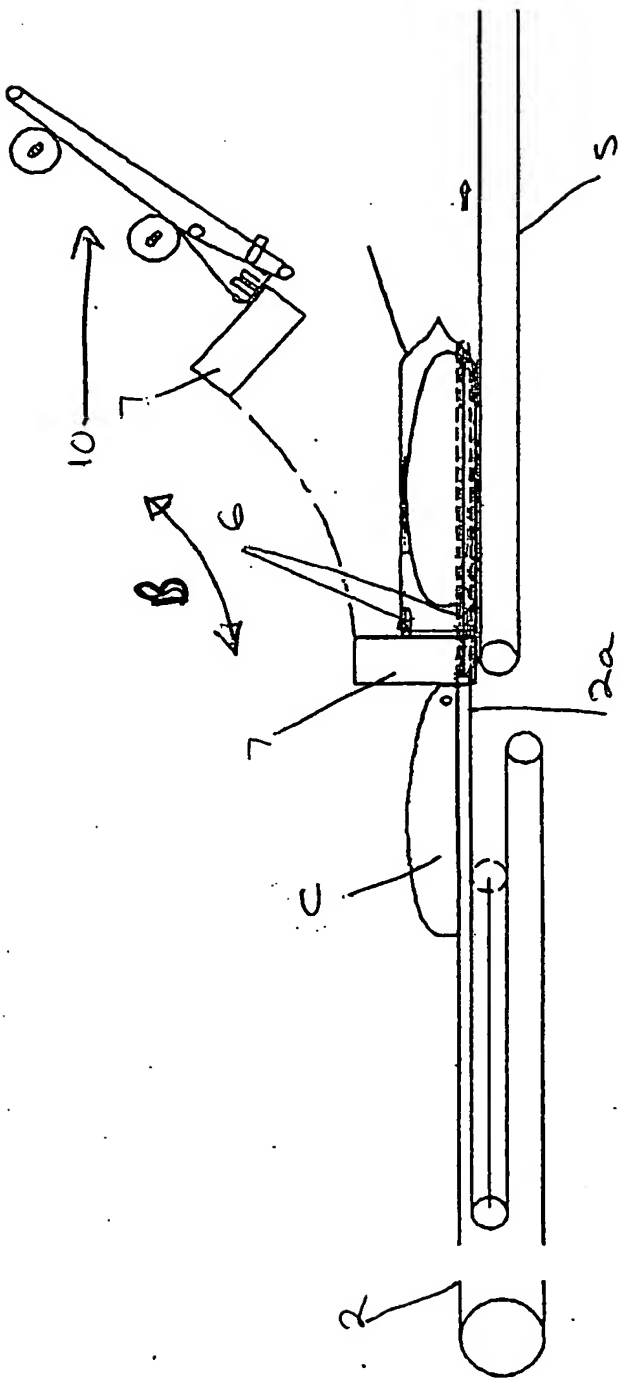


FIGURE 14

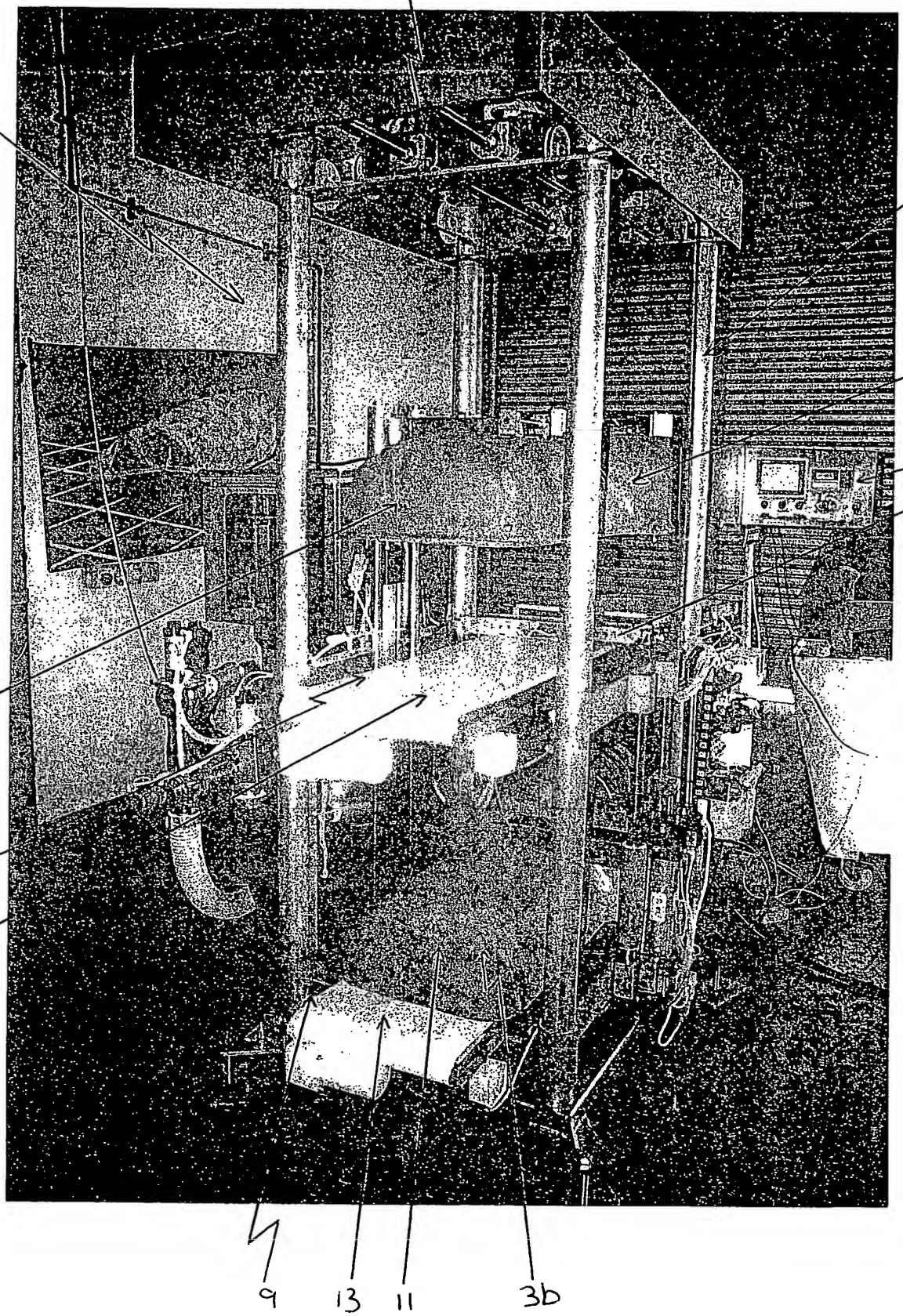


Fig 15

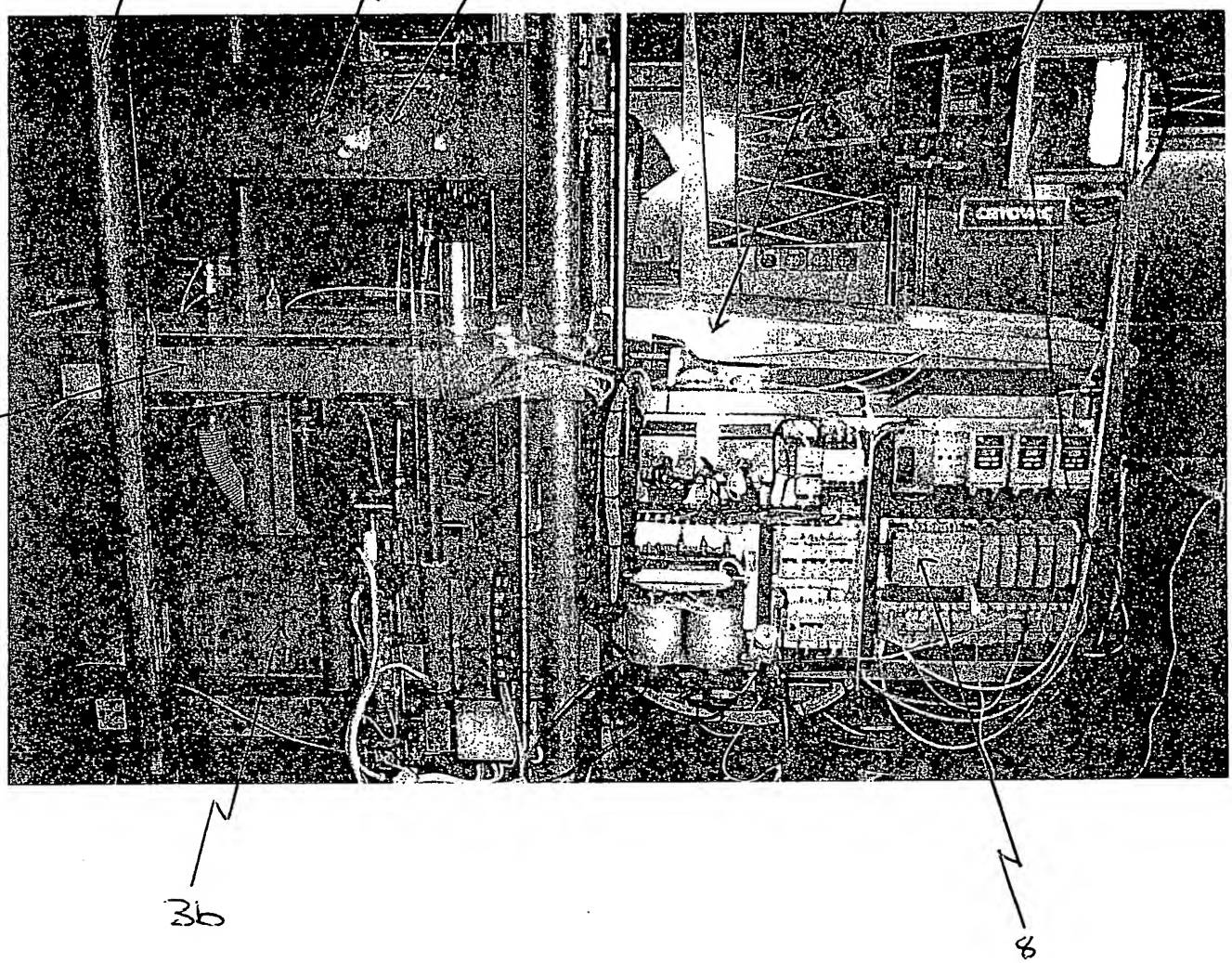


Fig 16

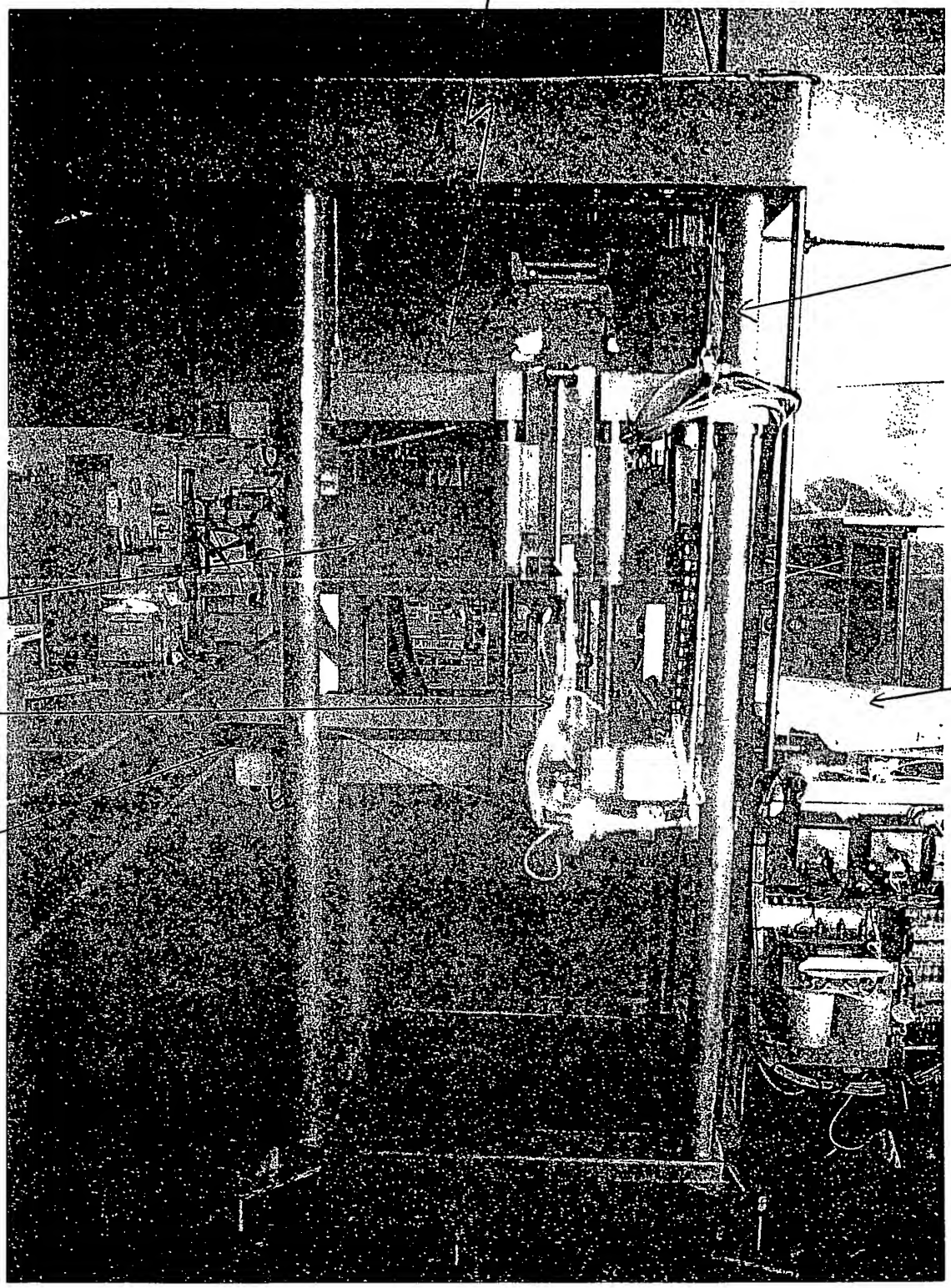


Fig 17

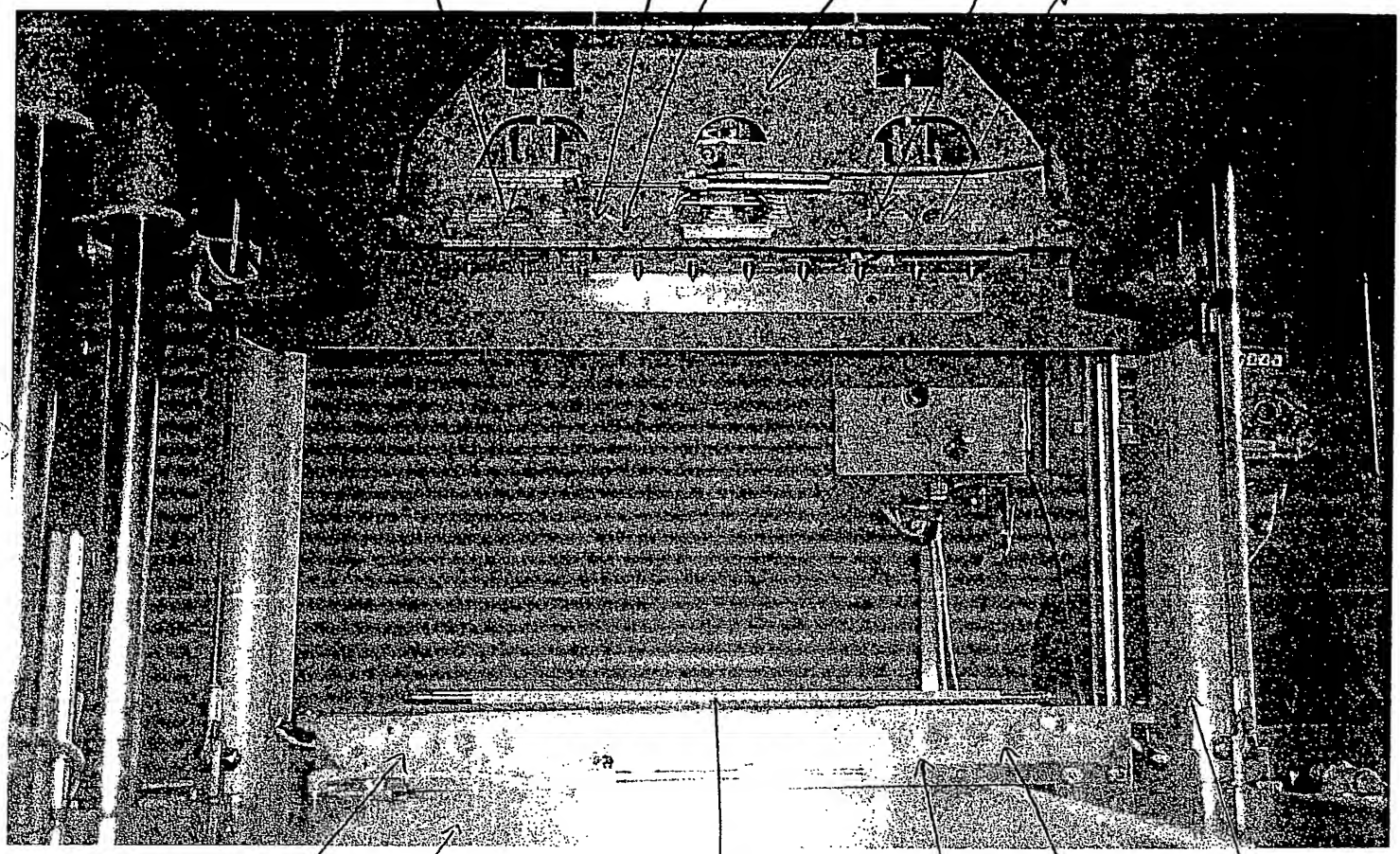


Fig 18

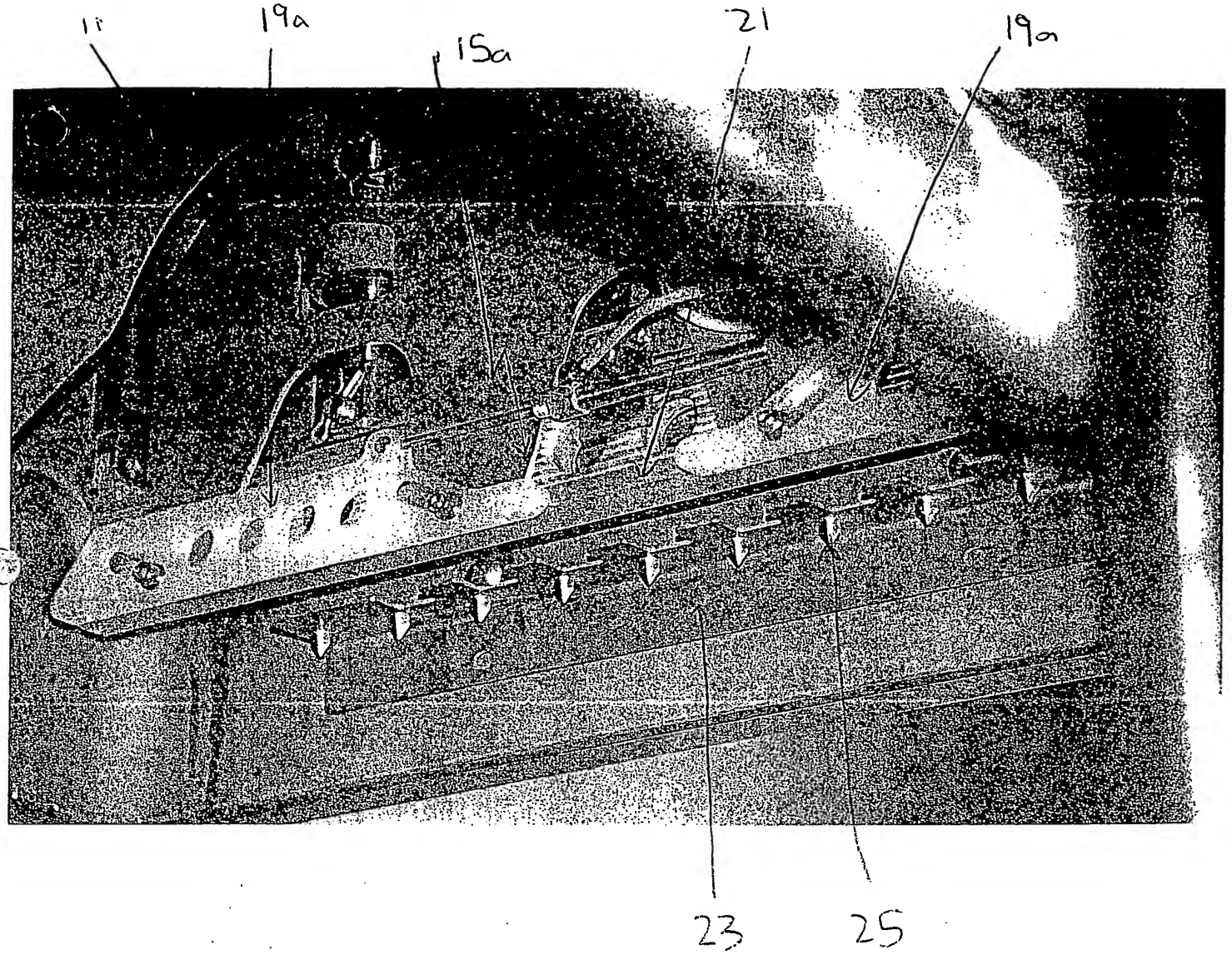


Fig 19

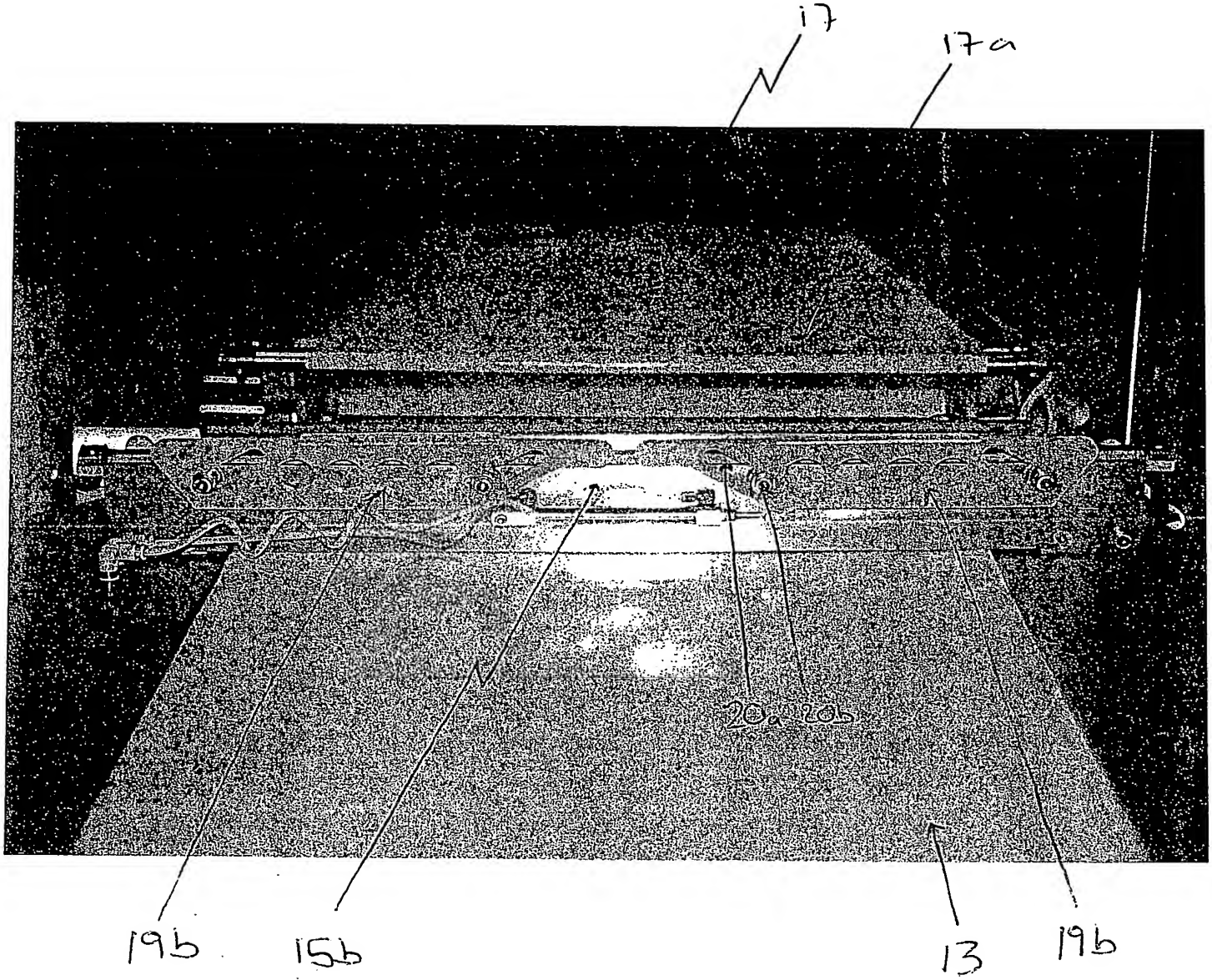


Fig 20

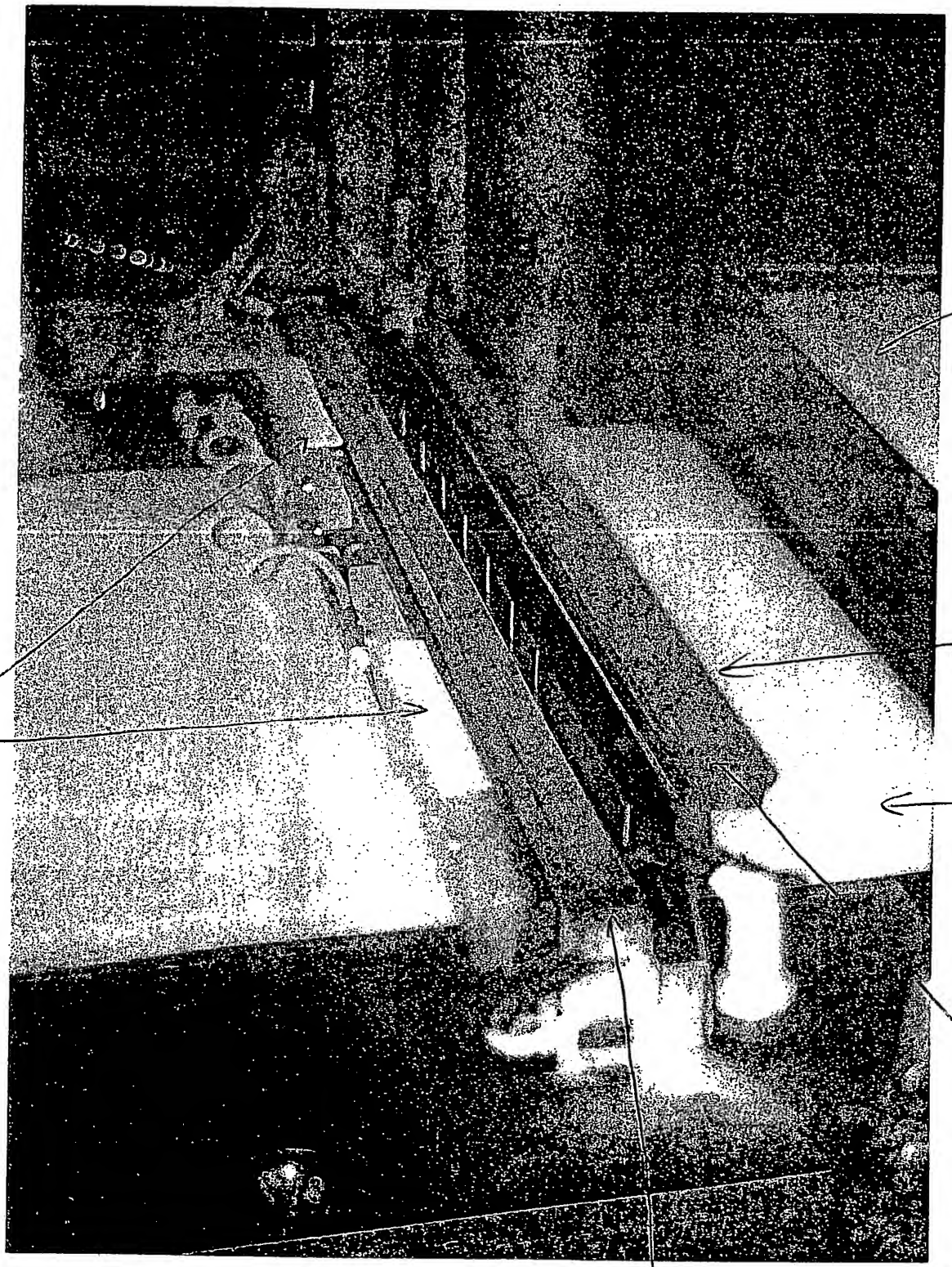


Fig 21

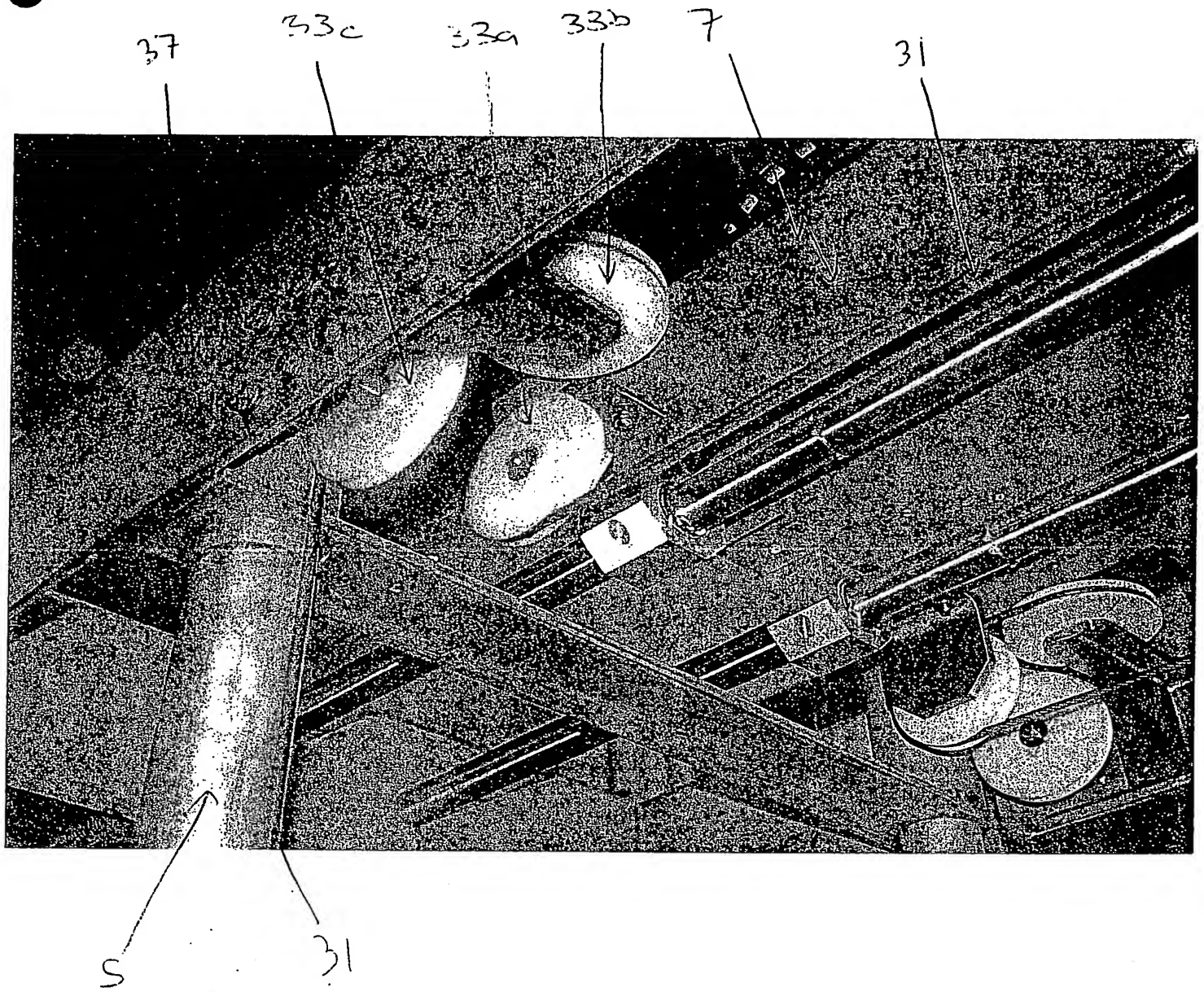


Fig 2a

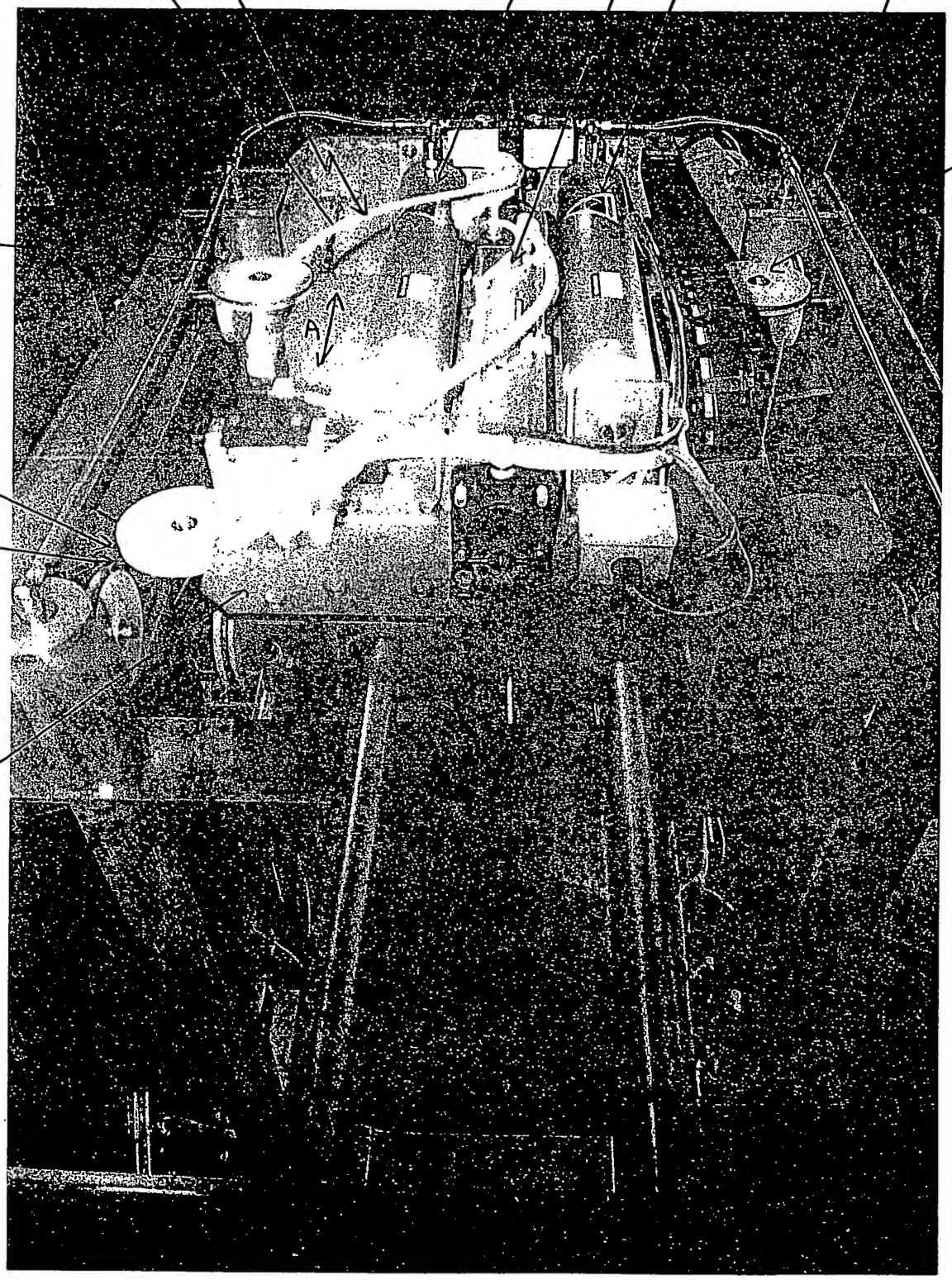


Fig 23

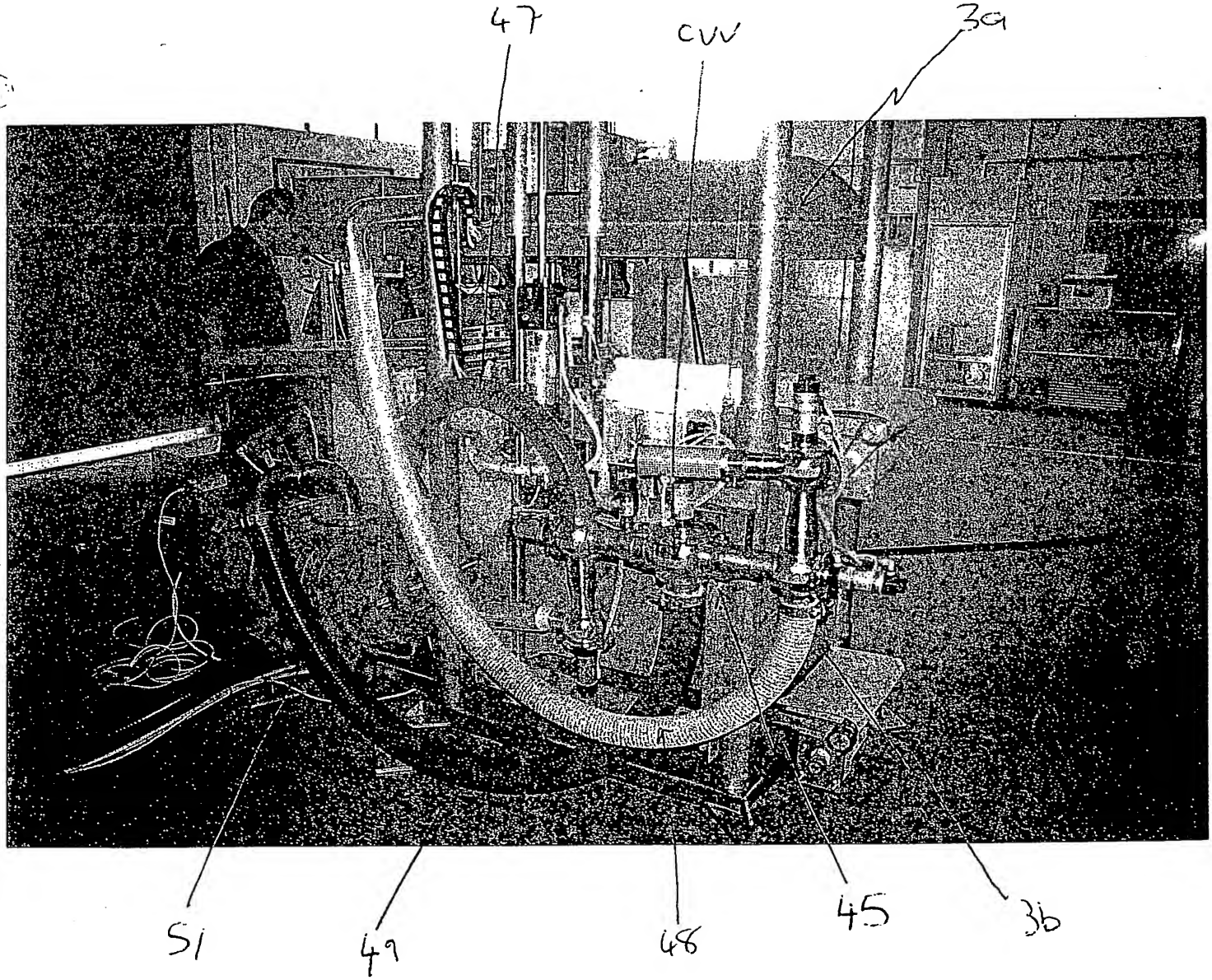


Fig 24

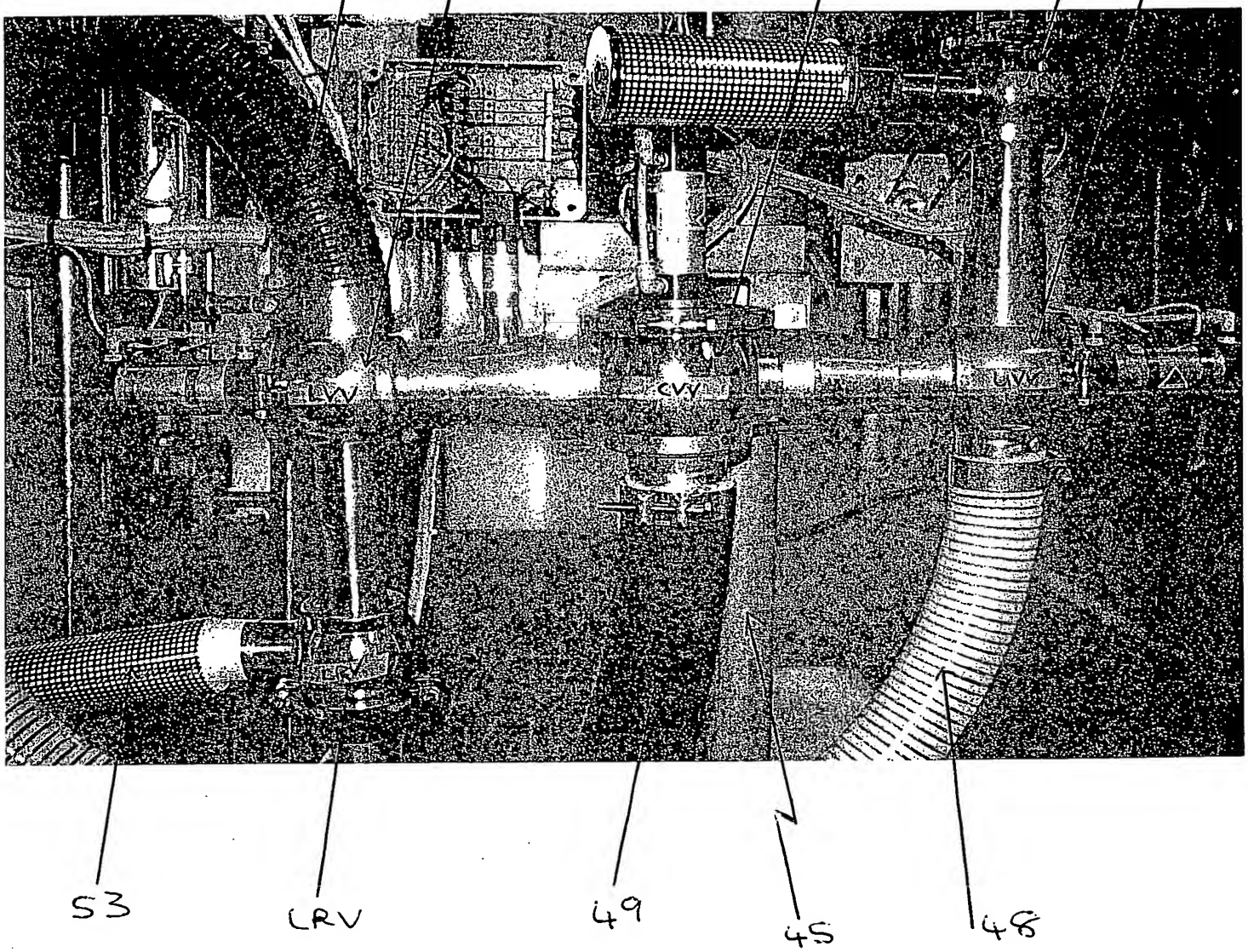


Fig 25

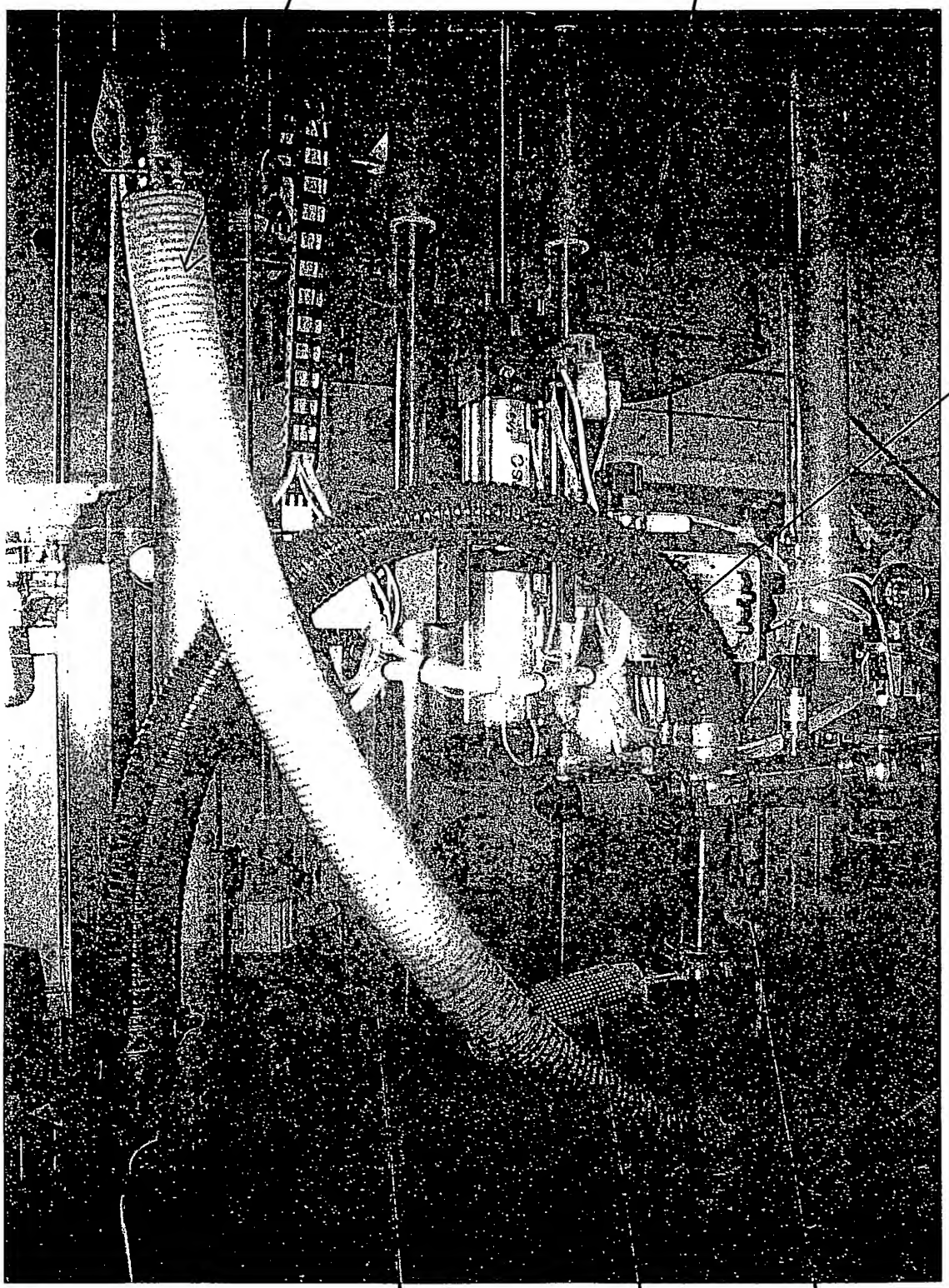


Fig 26